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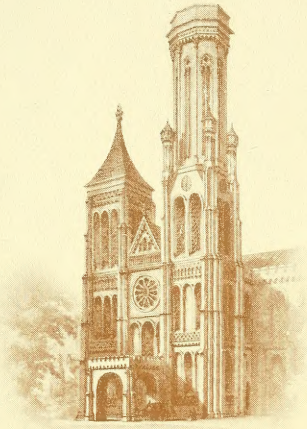

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To carry out the purpose for which it was founded thirty-two years ago, the National Geographic Society publishes this Magazine. All receipts from the publication are invested in the Magazine itself or expended directly to promote geographic knowledge and the study of geography. Articles or photographs from members of the Society, or other friends, are desired. For material that the Magazine can use, generous remuneration is made. Contributions should be accompanied by an addressed return envelope and postage, and be addressed: Editor, National Geographic Magazine, 16th and M Streets, Washington, D. C.

Important contributions to geographic science are constantly being made through expeditions financed by funds set aside from the Society's income. For example, immediately after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. So important was the completion of this work considered that four expeditions have followed and the extraordinary scientific data resultant given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures, evidently formed by nature as a huge safety-valve for erupting Katmai. By proclamation of the President of the United States, this area has been created a National Monument. The Society organized and supported a large party, which made a three-year study of Alaskan glacial fields, the most remarkable in existence. At an expense of over $50,000 it has sent a notable series of expeditions into Peru to investigate the traces of the Inca race. The discoveries of these expeditions form a large share of the world's knowledge of a civilization which was waning when Pizarro first set foot in Peru. Trained geologists were sent to Mt. Pelee, La Soufriere, and Messina following the eruptions and earthquakes. The Society also had the honor of subscribing a substantial sum to the historic expedition of Admiral Peary, who discovered the North Pole April 6, 1909. Not long ago the Society granted $20,000 to the Federal Government when the congressional appropriation for the purchase was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people and incorporated into a National Park.

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THE LAST ISRAELITISH BLOOD SACRIFICE

How the Vanishing Samaritans Celebrate the Passover on Sacred Mount Gerizim

By John D. Whiting

Author of "From Jerusalem to Aleppo," "Village Life in the Holy Land," and "Jerusalem's Locust Plague," in the National Geographic Magazine

Illustrated with the only set of night photographs ever taken of this ancient ceremony, and numerous other unique pictures, by the American Colony Photographers, Jerusalem, Palestine

SHECHEM, Samaria, and Neapolis were once great cities of the ancient civilized world. Today their glory and importance are no more, save in history. Here alone we find a dying and almost extinct community of Samaritans, the remnant of a once numerous sect, whose persistent continuation and literal performance of the Passover Sacrifice have attracted the attention of students for more than three centuries.

Nablus, the modern Shechem, the only home of the Samaritans of today, is a town of about 27,000 inhabitants, lying some forty miles north of Jerusalem. The population is chiefly Moslem, the remainder being composed of various Christian sects, together with a mere handful of Samaritans. But as yet no Jew has settled there, the Biblical axiom still holding good, "for the Jews have no dealings with the Samaritans."

Besides being a center of trade, Nablus has gained a little fame for its soap, made of pure olive oil, a variety which, though crudely manufactured, is used almost exclusively by the people of the city, and is much prized by the natives of Syria and Egypt.

The town nests in a confined valley running east and west, between twin mountains—Ebal, some 3,000 feet above sea-level, which looms up on the north, and the lesser Gerizim, about 150 feet lower, which closes in on the south, with its base in places only a few hundred yards from that of its mate.

From the lower slopes of Gerizim issue numerous and copious springs. The modern town has therefore crept up in their direction. These waters, after filling the demand made upon them by the city, find their way into extensive gardens to the west, where flourish fig trees, laden with delicious fruit, pomegranates hung with scarlet bloom and fruit, yellow quinces, walnuts, mulberries, olives, and occasional bitter-orange trees raised for the perfume extracted from the flowers. Among the trees many varieties of vegetables grow in abundance.

The houses of the town are dome-roofed and lattice-windowed, constructed from the soft, white limestone of Mount

NABLUS (THE MODERN SHECHEM), THE ONLY HOME OF THE SAMARITANS TODAY

The town nestles in the valley which lies between Mount Ebal and Mount Gerizim. The picture is taken from the lower slopes of Gerizim, near Ras el Ain, while Mount Ebal is seen in the background (see map, page 46).

Ebal. The streets are picturesquely narrow and most of them are paved with cobble-stones, with here and there an arch thrown across and supporting a room above.

THE HOME CITY OF THE SAMARITANS

In the "souks," or markets, as in most Syrian towns, the stores are so small that the customer stands outside to examine the meager display of European and native (Damascene) wares. Here are rows of silversmith shops, where the artisans work cross-legged, producing from crude silver elaborate ornaments for the peasant women. Here are the coffee shops, the street in front blockaded with men sitting upon low stools, sipping the thick, hot beverage from tiny cups and smoking the long, red-piped, bubbling narghile as they gossip and play a game of "tawla."

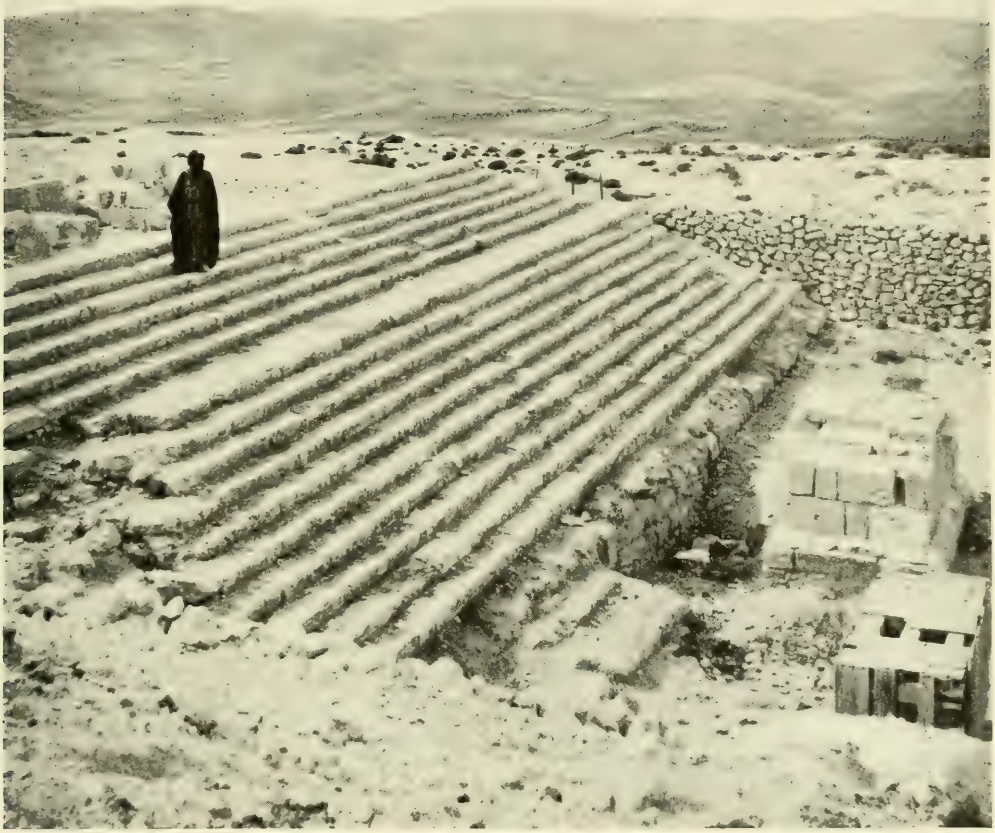
Next are the sweetmeat venders, from whose stalls large trays of "kanafie" protrude into the street. This pastry dish, for which Nablus is noted, has a filling of fresh, sweet cheese. After it is baked,

A STREET IN THE SAMARITAN GHETTO OF NABLUS

From the main market-place, long, dark, tunnel-like lanes lead to the Samaritan Quarter, at the foot of the sacred Mount Gerizim.

THE HILL OF SAMARIA

Omri, the sixth king of Israel, in the ninth century B. C., bought an isolated hill a few miles west of Shechem, where he built his capital and named it Samaria, after its original owner.



THE ACROPOLIS OF SAMARIA

The city of Samaria from its inception overshadowed its rival, Shechem, and perhaps under Roman rule attained the pinnacle of its glory. The Emperor Augustus presented it to Herod the Great, who rebuilt and embellished it after the Roman style and renamed it Sebaste.

melted butter and thick syrup are poured over it until it is literally soaked with the mixture.

From the chief market-place the Samaritan Quarter of Nablus is approached from the north through long, tunnel-like lanes which lead to the very foot of the sacred mountain.

Just above the city, Gerizim is steep and rocky, and the trees disappear. In summer the mountain side is gray and barren, but in winter even the smallest patches of earth are scratched with primitive plows and sown with wheat or barley.

THE FRIENDLY CACTUS

Across from the town the slopes of Ebal present a very different picture. Equally rocky, they are still perennially green with cactus bushes planted among the rock ledges, which are curiously studded with ancient sepulchers, whose open doors from a distance reveal only the

REBURYING AHAB'S PALACE: SAMARIA

The enormous quantity of earth removed by the American excavators in clearing these ruins was conveyed in baskets on the heads of women, who, like ants, formed an endless chain of toil, running back and forth. Once the archeological researches had been made, the ruins were again filled with the dust of remote ages, thus preserving them for future generations as well as returning the land to its owners in its original state.

RUINS OF THE ROMAN FORUM AT SAMARIA

Note the weather-beaten tops of the columns, while the lower parts retain their original whiteness, showing how deep these ruins were covered by débris when the work of excavation was undertaken, with the aid of American research funds, under the auspices of the Museum of Fine Arts, Boston.

darkness within. Some of these tombs were rifled centuries ago; others have come to light within the past few years. Many have stone doors and stone hinges, with stone locks still in working condition if the keys, probably of bronze, could be found.

But the modern inhabitants do not pride themselves on this interesting cemetery, as did the peoples of bygone times. To the Arabs of today antique relics are of no import; but they feel justly proud of the cactus or prickly-pear bushes, which present a weird spectacle and cover every available space in this oriental God's Acre. The fame of these bushes reaches as far as the Bosporus, where the much-prized fruit is a favorite gift among the notables of Constantinople.

The prickly-pear cactus was first introduced into Palestine by the Crusaders; today it is grown throughout the length and breadth of the land, being valuable not only for its fruit, but also as an ex-

SAMARITAN GIRLS LEARNING THEIR ANCIENT HEBREW

Note the latticed windows, used so extensively in the East to prevent men in the neighborhood from looking into the women's apartments.

A VIEW OF MODERN SEBASTE AND THE SURROUNDING HILLS

After climbing to the zenith of might, Sebaste slowly relapsed into insignificance. Today, amid the ruins of a splendid past, a squalid mud village occupies the site and retains the name.

cellent hedge. The natives, however, do not yet appreciate its great value as forage for cattle. The camels help themselves to it whenever they get a chance, their mouths being so tough that, regardless of the spines, they devour the leaves with unmistakable relish. The Ebal cactus' superiority lies in the extra large size of its fruit, the tenderness of its seeds, and its sweet and luscious flavor, due both to the peculiar soil and to the protection afforded from the cold north winds. The Arabic name for the pear, *sabbir* (patience), seems eminently appropriate to one who has innocently handled the unpealed fruit and had his hands filled with the microscopic spines, which can be extracted only by painful laboriousness.

SHECHEM, WHERE THE BIBLE INTRODUCES ABRAHAM

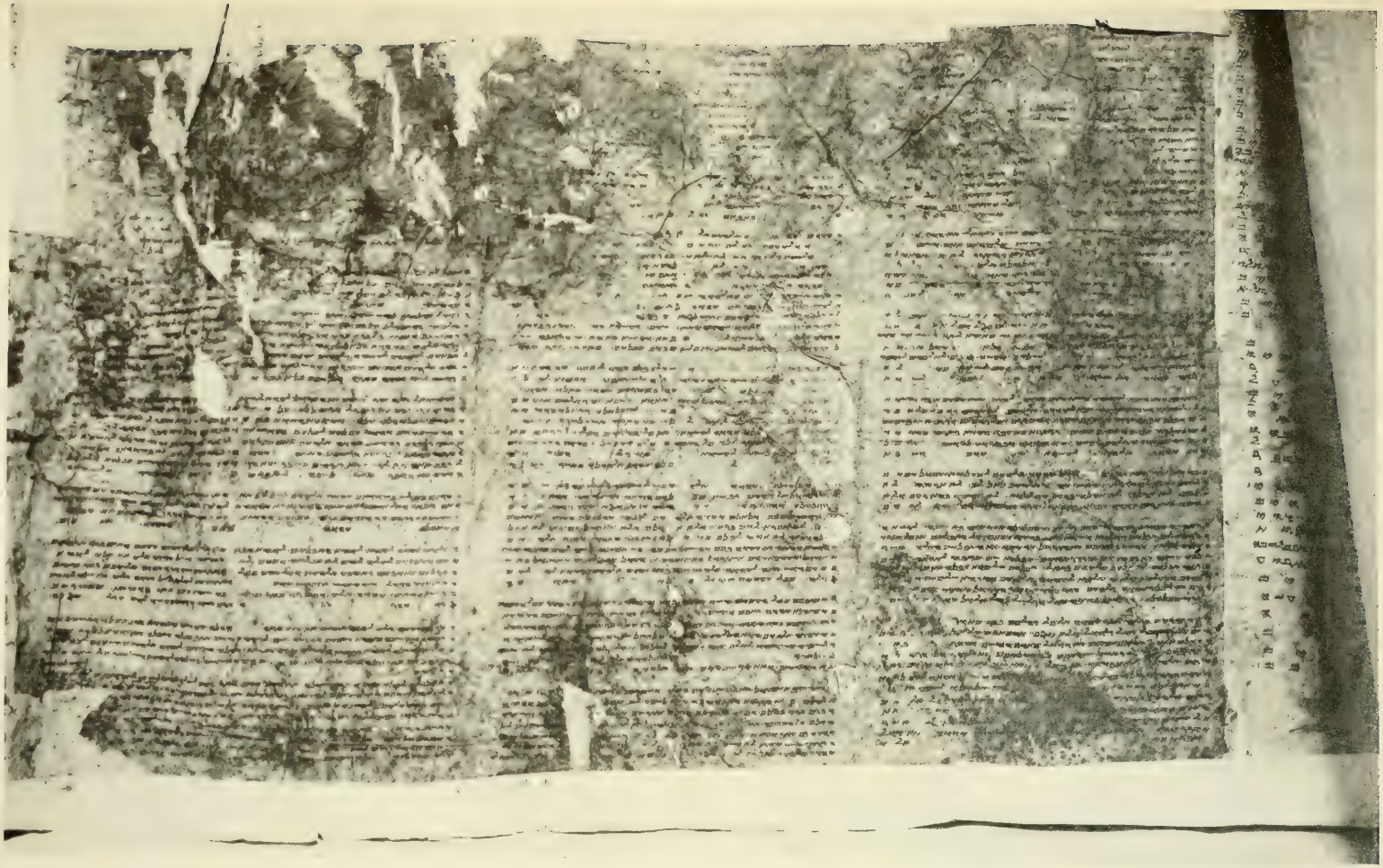
The first city built in this valley was Shechem, which occupied a site a short distance to the east of Nablus. Here, at the highest point of the valley, where the rains to the east find their way to the Dead Sea and those to the west to the Mediterranean, is a small artificial hill. Recent excavations by archeologists have revealed a city wall encircling the re-

THE SAMARITAN SYNAGOGUE

This, the only house of worship which the Samaritans possess, is a very plain building and only a few hundred years old. In the recess to the left, behind ornamented curtains, are primitive safes and cupboards containing many parchments and Pentateuchs, among them the noted Abishua Codex (see illustration, page 12).

ONE OF THE SYNAGOGUE CURTAINS

This silken curtain, heavily embroidered in gold, is used in the synagogue to hang in front of the scroll chests. The designs represent the cup of manna, ark of the covenant, Aaron's rod blossoming, the seven-branched candlestick, the table of shew-bread, the golden censer, and other temple furnishings such as existed in the temple at Jerusalem.



THE FIRST PHOTOGRAPH EVER TAKEN OF THE ABISHUA CODEX, PROBABLY THE OLDEST COPY OF THE FIRST FIVE BOOKS OF THE BIBLE IN EXISTENCE

The date inscription on the scroll presents to the Samaritan mind indisputable proof that it was written by the great-grandson of Aaron in the early years of the entrance of Israel into Canaan. This Scroll of Abishua, as it is known, has now for the first time been photographed from end to end and will be published in exact life size. It is hoped that when these photographic copies are available to Hebrew students new light may be thrown upon many Scriptural controversies.

mains of houses and have laid bare numerous ancient earthenware vessels.

As we look upon these primitive habitations, more than 3,000 years old, it is hard to realize that we are not actually looking on the oldest city built here, but upon a town that, at this early date, had already had a long existence.

It is at Shechem, then called "Sichem," and the plain of Moreh, into which the Shechem gorge opens at its eastern extremity, that Biblical history introduces Abraham, the father of the Hebrews, in Canaan. Likewise Jacob made this locality his first halt on returning from his sojourn with Laban in Haran. Here he purchased the parcel of ground whither, at a later date, Joseph's bones were brought from Egypt to be buried, and where today Jacob's well is pointed out as the spot at which Jesus and the Samaritan woman met (see map, page 46).

Immediately following the Israelitish invasion of Canaan and the taking of Jericho and Ai, Joshua built upon Ebal the first altar of sacrifice erected by his people in the new land.

The Shechem Valley now became the theater of the first general convocation, and, according to the Mosaic injunction, the whole congregation was assembled, "half of them over against Mount Gerizim and half of them over against Mount Ebal." From Ebal were to be proclaimed the curses against those who should forsake the law of their God, and from Gerizim the blessings that would result in the following of *Yahweh* (the unpronounced Hebrew name for God).

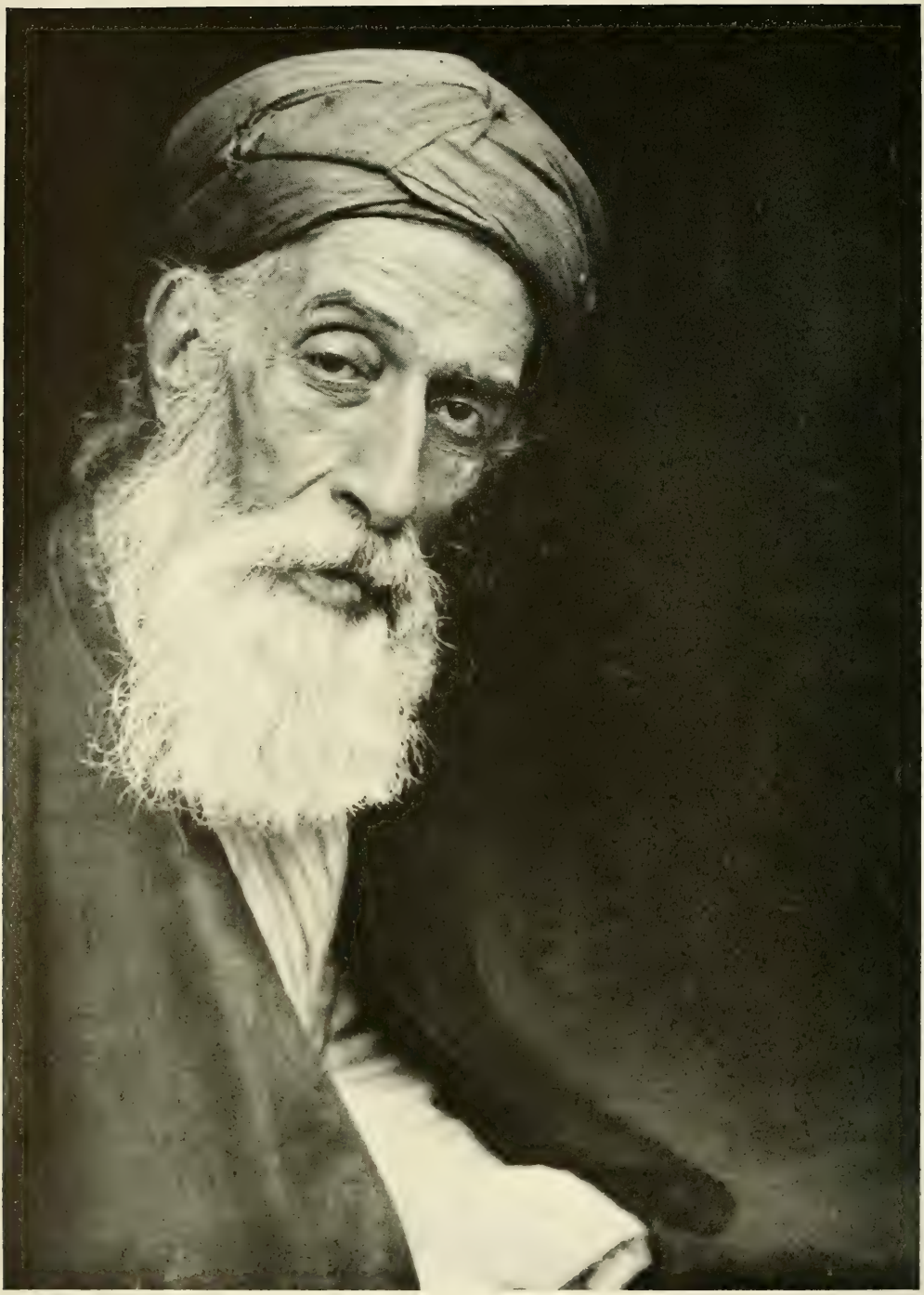
Here also, just before his death, Joshua addressed the last assembly of the people, making a covenant with them.

We now come to the broader period of its history. Ephraim, destined to figure as the leading tribe of the Northern Kingdom, had the lot of its possession fall to the district wherein Shechem lay. This territory was then known as "Mount Ephraim."

The town of Shechem itself was apportioned to the Levites, since they, being a tribe of priests, received no inheritance except cities and their suburbs in which to dwell throughout all the tribes. Shechem was also selected as one of the cities of refuge, and throughout the Hebraic occupation held an important place.

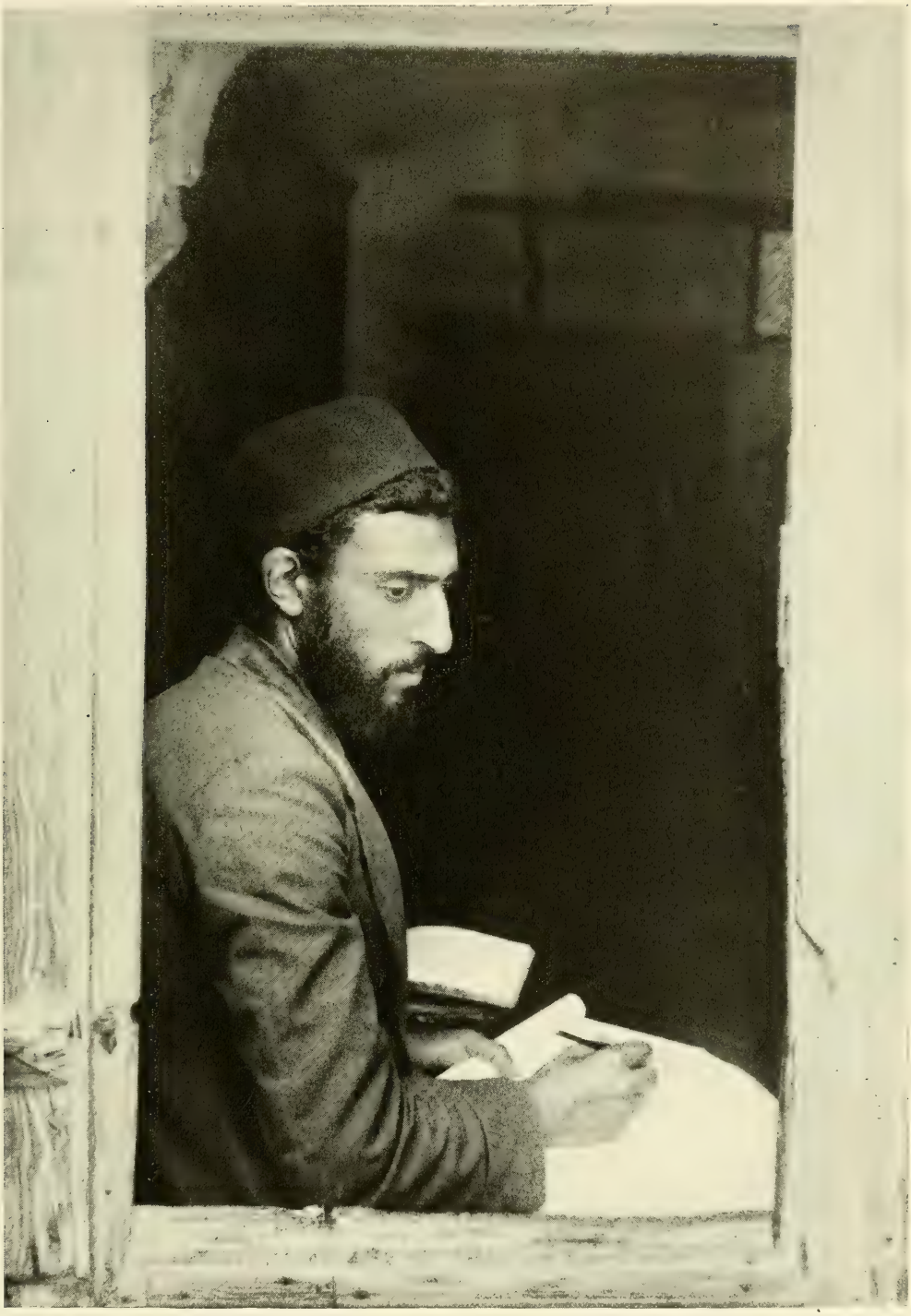
ABU EL HASSAN, SON OF THE LATE HIGH PRIEST JACOB

All the Samaritan priests wear long hair, which they wind under their dome-shaped fezzes. "And the Lord said unto Moses, speak unto the priests and say unto them that they shall not make baldness upon their heads; nor shall they shave off the corner of their beards' (Lev. 21 : 1-5).



JACOB, SON OF AARON, LATE SAMARITAN HIGH PRIEST

Members of the present priestly family trace their ancestry to the tribe of Levi. The direct Aaronic line that existed till modern times has now failed.



A YOUNG PRIEST WRITING A SAMARITAN PENTATEUCH

All the Samaritan Pentateuchs and prayer books, as well as the books used by the school children, are hand-written. Parchment was used up to two centuries ago; since then paper has come into vogue. Aside from the fact that the poverty of the modern Samaritan commends the use of paper, which is much cheaper, the orthodox scholar will not write on leather unless the hide from which it is prepared has been taken from an animal slaughtered by a priest.

THE VILLAGE OF ASKAR, ANCIENT SYCHAR

Just behind the village is Jacob's well. The mountain in the background is Gerizim, while the mosque on its summit marks the site of the Samaritan temple to which, no doubt, the Samaritan woman pointed when conversing with Jesus.

During the period of the Judges little of importance is heard of Mount Ephraim, except that Abimelech, son of Gideon by a Shechemite concubine, was made "King" of Shechem, and ruled three years.

With the advent of David came the Golden Age of the Hebrews. The capital was moved to Jerusalem, where, upon his succession, Solomon built the renowned Temple and established thereby a center of worship.

But this unified kingdom was short-lived, and with the death of Solomon, his son, Rehoboam, proceeded to Shechem, where all Israel was gathered to make him king. Instead of this being consummated, ten tribes revolted and made Jeroboam, an attaché of Solomon's court, king. Jeroboam selected Shechem as his home. Thus the northern ten tribes established the Kingdom of Israel, now forever rent from the Kingdom of Judah, which was composed of the two remaining tribes, Judah and Benjamin.

NEAR SYCHAR IS JACOB'S WELL; ITS DEPTH IS INDICATED BY THE LENGTH OF THE ROPE

To the east, towering above the encampment, is the loftiest of Gerizim's peaks, crowned with ruins—a spot where once temples stood.

THE SAMARITAN PASSOVER CAMP, THE ONLY REMAINING ISRAELITISH CAMP IN THE WORLD

To the east, towering above the encampment, is the loftiest of Gerizim's peaks, crowned with ruins—a spot where once temples stood.

LAMBS SELECTED FOR THE SACRIFICE OF THE PASSOVER

THE CONGREGATION GATHERING FOR THE SACRIFICIAL CEREMONY

As they assemble one by one they spread small prayer cloths upon the ground. Upon these they stand with bare feet, having dropped their prayer slippers behind them.

THE SAMARITAN HIGH PRIEST JACOB LEADING THE PASSOVER SERVICE

Note the prayer cloth on which he stands. Some of these have the prayer-niche design identical with those of the Moslems. The Samaritans always face their Holy of Holies (the holy rock on the crest of Mount Gerizim) when worshiping.

THE TRENCH-ALTAR PREPARED FOR THE SAMARITAN PASSOVER

Two large copper kettles filled with water are placed over this altar. At a short distance, and higher than the altar level, is the *tanoor,* or ground oven, for the sheep-roasting. The men in the right background are tending the oven.

Omri, the sixth king of Israel, in the ninth century B. C., bought an isolated hill a few miles west of Shechem, on the north side of the valley, and there built his capital, naming it Samaria, after its original owner. At the time of the First Captivity the Kingdom of Israel lost its northernmost tribes and its possessions beyond the Jordan. From them Galilee was then created, while the remaining southern part inherited the name of its once important capital, Samaria, and became a State subject to Assyria. Thus was the land cut up into three districts—Galilee, Samaria, and Judea.

SEBASTE, CITY OF HEROD

The city of Samaria, from its inception, overshadowed its rival, Shechem, and probably attained the height of its glory under Roman rule; for the Emperor Augustus presented it to his procurator, Herod the Great, who rebuilt and embellished it after the Roman style, and renamed it Sebaste (Greek for Augusta). Much of Herod's work still remains, notably a double colonnade encircling the hill's crest.

An Arab proverb says, "Beyond every mountain ascent there is a descent." And Sebaste, after climbing to the zenith of power, slowly relapsed into insignificance; so that today, amid the ruins of its splendid past, a squalid mud village bears the once grand title (the name in Arabic being slightly altered to "Sebastieh"). Here is a rare instance, possibly the only one in Palestine, where the Greek name has outlived the older Semitic form.

Sebaste had become a place of no importance more than four centuries before the Emperor Vespasian founded Neapolis (New City) in the Shechem vale, west of the older town, in 67 A. D. This "New City" soon outstripped the older Shechem, and in the fourth century became one of the foremost cities of Palestine—a distinction which it still enjoys under its Arabic name of Nablus.

THE ANCIENT HEBREW PRAYER POSTURE SURVIVES TODAY ON MOUNT GERIZIM

So reverent were the ancient Hebrews that the name of their God never was pronounced publicly, a fact which gave rise to the "coined word," Jehovah, by which the God of the Old Testament Israel now is known. The proper term was "Yahweh." When this word occurred in Hebrew texts another name, "Adonay," was substituted by the priest, and to warn the reader against pronouncing the Holy "Yahweh" the substitute word frequently was printed under the true name. When the Christian translators of the Middle Ages undertook to make the Bible intelligible to the peoples of Europe they apparently did not know what to make of this double term, so they combined the consonants of "Yahweh" with the vowels of "Adonay" to form the "Jehovah" of the King James version.

The Samaritan religion is closely akin to that of the Jews, the chief differences being that the cult of the former centers about Gerizim, while that of the Jews centers about Zion, and that the Samaritan canon of Scripture is restricted to the Pentateuch, or "Five Books of Moses." The later writings, including the Prophets and Psalms, the Samaritans repudiate as uninspired.

In view of the similarity in their beliefs and practices, it seems strange that there exists and always has existed the fiercest animosity between Jew and Samaritan, but it is the animosity that invariably exists between an original and a schism.

The Samaritans maintain that they are the remnants and descendants of the once great tribe of Ephraim, and that the split between them and the Jews came about through the maladministration of the priesthood by Eli's sons. Followers of the Jewish Church are looked upon as dissenters from the pure faith of Israel, and the forming of a center of worship in Jerusalem by Judah is condemned upon the ground that the land of Ephraim, with Shechem and its mountains, figured in the earliest history of the Hebrews; that here the first Israelitish altars were erected, and that these were the only specific parts of the Land of Promise mentioned by Moses in the wilderness.

THE RENOWNED SAMARITAN SCROLL PHOTOGRAPHED AT LAST

The most precious document of this sect is the renowned Samaritan scroll Pentateuch. This scroll is some seventy feet long, and toward the end its columns are divided vertically by a small gap, often occurring between the letters of the same word. Into this gap is carried and written any letter that occurs in the lines which fits into the writing of the date, so that when reading the text it fills its place, while on the other hand these separated letters when read collectively from the top of the column to the bottom, like the Chinese, spell out the name and date of the writer, etc., thus making it impossible for the date to have been of a later writing than that of the scroll itself.

The Samaritans assert that the scroll was written by Abishua, the great-grandson of Aaron, in the early years of the entrance into Canaan, but no impartial student will allow it this very remote origin, although it is believed to be the most ancient copy of the Pentateuch in existence.

So jealously guarded is this scroll that few non-Samaritans have ever seen it, and many of the Samaritans themselves have not seen it except as it is exhibited on rare occasions at feasts, rolled up and covered with a silken cloth and with but one column exposed.

The scroll has recently been photographed from end to end, and will soon be published for the benefit of Hebrew scholars.

It is, of course, impracticable to display this very fragile parchment continually, but it is unfortunate that the modern Samaritans impose upon their guests by showing them a scroll of much later date than the one which all so covet to see. The imposition has gone further, for all photographs made heretofore supposedly of the original Abishua scroll, as it is called, have in reality been of the later copy.

While the Jews have scattered all over the world since the captivities and have absorbed much that is foreign, in many instances adapting their religious practices to their new environment, the Samaritans have during the same lapse of time lived in the land of their forefathers, among Semitic peoples akin to the Hebrews, and because of this fact have handed down to the twentieth century a glimpse of the old Jewish Church almost in its purity. A notable instance of the survival of an ancient religious ceremony is the celebration of the Passover Sacrifice.

One of the distinctive differences between the Samaritan and the Jew lies in their methods of computing the calendar. Instead of adopting the lunar year solely, the Samaritans base their calculations on the moon but they are at the same time also governed by the movement of the sun. The system is so complicated as to form one of the chief studies of the young priests. Basing their authority on the first chapter of Genesis for thus differentiating from the Hebrew calendar,

KILLING THE PASSOVER SACRIFICE

The caldrons of water are already boiling. "Then shall all the convocation of the assembly of Israel slay it between the two evenings." As these words are read, with one deft stroke downward, each of the three slaughterers cuts the throat of one lamb and jumps to the next.

THE SPITTED SACRIFICIAL LAMBS

On oaken spits slightly longer than the depth of the ground oven, the dressed lambs are placed lengthwise, the heads hanging down. "Eat not of it raw, nor sodden at all with water; his head with his legs, and with the purtenance thereof."

they point out that, in the history of creation, when the sun and moon are introduced, it is said of them jointly, "Let them be for signs, and for seasons, and for days and years" (Gen. 1:14). For the above reasons the Samaritans some years celebrate their Passover with, or nearly with, the Jews, while at other times their fourteenth of Abib comes a month behind.

PREPARING FOR THE FEAST OF THE PASSOVER

A few days before the Passover the Samaritan ghetto becomes the scene of much activity. Mules and donkeys are loaded with tents and other necessities, while young and old, sick and well, quit their homes to make the pilgrimage to Gerizim, in obedience to the command, "Thou mayest not sacrifice the Passover within any of thine own gates, but in the place which Yahweh thy God shall choose to make a habitation for His name." Often, persons seriously ill are carried in their sick beds to the camp, and here not infrequently babes are born.

Prior to the date appointed, much time is spent in arranging the camp, rebuilding the *tanoor,* or ground oven, used in

roasting the sacrifice, and in procuring the necessary wood and brush for fuel.

The ascent to the camp spot on Gerizim requires usually an hour, whether mounted or on foot. Nablus is left behind by a path leading up from its western suburbs, and passing the Samaritan cemetery, an open field, its rocky and stone-strewn surface overgrown with weeds on which donkeys and cattle may be seen browsing. The trail leads up in short, stiff, winding courses through a slight depression where olives and other trees grow vigorously. The way soon becomes so steep that beasts as well as pedestrians are forced to halt at intervals for breath. But the time is not wasted, for the view of the town in its glaring whiteness below, fringed with verdant gardens and nestling between the twin mountains, is a scene truly beautiful.

THE ENCAMPMENT OF THE ISRAELITES

Once up this steep ascent, the ridge is gained. Along it the path, now fairly level, leads to a slight depression in the saddle, where suddenly the visitor sees before him more than forty white Egyptian and Damascus tents, the only veritable Israelitish encampment of religious significance in the world.

A pity it is that these more modern tents are used instead of the primitive goat-hair ones of the Bedouins, which would more nearly, if not entirely, resemble those used during the Exodus.

To the east, towering above the encampment, is the loftiest of Gerizim's peaks, crowned with ruins, a spot where once temples stood.

It is Passover eve. Selected sacrificial lambs are contentedly wandering about, unconscious of their impending fate. They have been purchased some days in advance of the Passover, in obedience to the law, "in the tenth day of this month they shall take to them every man a lamb. . . . Your lamb shall be without blemish, a male of the first year. . . . And ye shall keep it up until the fourteenth day of the same month."

But the scene is not quiet. Scores of people, non-Samaritan, young and old, have come up to "smell the air," for to the Nablus people, and especially for the lads, it is a day of excitement not to be missed.

The camp ground is a small, elongated field, the property of the Samaritans. No special system is observed in pitching the tents, beyond leaving a path between the two uneven rows. Each family has one tent; a few have two.

At the eastern extremity of the camp is the *kiniseh* (synagogue), where the religious rites are observed while in camp. It is a small, oblong plot surrounded by a low rubble wall except to the east, where terrace above terrace, now much dilapidated, rises in step form to the mountain crest beyond.

THE TRENCH-ALTAR

At the northern end of this space, or prayer inclosure, a trench has been dug and lined with uncut stone. "An altar of earth shalt thou make unto me. . . . And if thou wilt make an altar of stone, thou shalt not build it of hewn stone; for if thou lift up thy tool upon it, thou hast polluted it."

Across this altar two large copper kettles, filled with water, are placed. Beyond the northeastern end of the inclosure, and higher than its level, is the *tanoor*, or ground oven, for the sheep-roasting. It is a pit, the depth equal to a man's height, from five to six spans in diameter, and lined in a circular form, like a well, with rough stones. Here the rock crops out so near the surface that, in order to get the *tanoor* deep enough, it has to be built partly above the surface and a terrace filled in about it, thus of necessity elevating it above the rest of the space devoted to the Passover observances.

It is about three hours before dark as we arrive, and since the Samaritan time starts its count from sunset, let us forget our Western watches while we remain on Gerizim's heights.

On approaching the camp, one of the first things to attract our attention is the cloud of smoke pouring forth from the *tanoor* and curling skyward from beneath the kettles, for five hours of steady heat produced by burning "saris" brush and thorn bushes are required before the oven is ready for fleecing the sheep.

THE SALT COVENANT

As the preparation of each lamb is completed much salt is rubbed into the flesh. "And every oblation of thy meat offering shalt thou season with salt, neither shalt thou suffer the salt of the covenant of thy God to be lacking from thy meat offering."

"NEITHER SHALL YE BREAK A BONE THEREOF"

No forks, knives, or spoons are used at the feast and great care is observed not to break a bone. The fingers are the Samaritan's only eating utensils on this occasion.

EATING THE PASSOVER

The members of the six families collect, each around one of the lambs—men, women, children, and nursing babies.

To escape the confusion caused by the swarms of sight-seers, boys galloping about on their horses or urging on lazy donkeys, hawkers calling out in loud voices as they peddle small cakes, oranges, or sweetmeats, we follow a friend, one of the priests, up to the crest of Gerizim. This, to the Samaritan, is the holiest part of the earth and crowded with sacred spots and associations.

THE SACRED SITES OF GERIZIM

Here one is shown the place where Joshua built the first altar of sacrifice with twelve stones taken from the Jordan. Just above it are the foundations of St. Mary's Church, built by the Emperor Zeno and restored by Justinian. Adjoining these ruins is a small domed mosque, Sheik Ghanim, now in a neglected condition. A Moslem shrine and a Christian church each in succession built on the site from materials supplied by the remains of a Roman temple!

Proceeding southward along the outmost ledge of the plateau, the priests point to spots where tradition says the altars of Adam and of Noah stood. Be-

"YE SHALL LET NOTHING OF IT REMAIN UNTIL THE MORNING"

The feast itself is of short duration. After the meat has been eaten the high priest, leaning picturesquely upon his staff, recites a short prayer. Every bit of bone remaining is now collected and taken to the altar. "And that which remaineth until the morning ye shall burn with fire." Note the two crouching figures in the foreground busily engaged in collecting and eating fragments of the roasted meat.

low is the path by which Adam was expelled from Paradise, after having been created from the dust of Gerizim.

Beyond is the altar of Seth, a stone circle with a pavement of large uncut stones (probably of megalithic origin).

Just beyond Seth's shrine, farther south, is a ditch sunk into a rock protruding boldly from the mountain side. It is the Samaritan rival to Mount Moriah, in Jerusalem. Here the Samaritans believe that Abraham prepared to offer up in sacrifice his only son, and just behind is the place where the ram was found caught in the thicket.

Almost at our feet, far below, in the plain of Askar (Sychar), lay Jacob's well, concealed beneath an uncompleted church erected upon Crusader foundations. Under the spell of the hour and the scene, one could almost picture the Samaritan woman pointing to Gerizim and saying to Jesus, "Our fathers worshiped in *this* mountain, and ye say that in Jerusalem is the place where men ought to worship" (John 4: 20).

THE SAMARITAN HOLY OF HOLIES

In the center of the plateau is a large flat rock which the Samaritans call "Kuds el Akdas"; for, according to their tradition, it formed the Holy of Holies of their temple. They approach it only on certain festal occasions and with bared feet. This rock at once calls to memory the rival Rock Moriah lying beneath the gorgeous Dome of the Rock in Jerusalem.

Although less extensive than that from its taller mate, Mt. Ebal, which cuts off the distant Galilee view northward, the scene from Gerizim is broad and grand. In the spring the Plain of Moreh, or Sychar, just at its feet, is a patchwork of small fields in different stages of growth. Near the village of Askar (Sychar), watered from a copious spring, large patches of onions and garlic flourish, their green varying with that of the waving barley and wheat beyond and contrasting with the bare and rocky surrounding hills. The elevations are dotted with villages, and among them, to the southward, is Awerta, where, under the shade of a great tree, the tombs of Aaron's son and grandson, Eleazer and Phinehas, lie.

Directly to the east, separated from the foreground by the deep Jordan chasm, rise the Mountains of Gilead. Like Moab, of which they are a continuation northward, they are suffused with a mysterious and fascinating translucent blue, resembling some precious stone, and never cease to captivate the vision, especially upon clear days. The highest peak, Jebel Osha, crowned by the reputed tomb of Hosea, stands out conspicuously. Towering at the head of the Jordan Valley, Hermon, with its perennial snow-cap, closes the northern limit of this eastern view.

At the foot of Mt. Ebal and bordering upon the plain directly below us are the excavations of ancient Shechem. Near them a small white dome marks the traditional site of the tomb of Joseph. Southward the view stretches over the long mountain range which is the backbone of Palestine, rising between the Phœnician plain and the deep Jordan chasm. When viewed from the Mediterranean, the only break seen in the range is this Valley of Nablus, while its rivals in historic importance, Jerusalem and Hebron, are hidden from view. Mizpah is easily visible, but no glimpse of Jerusalem save a little of its suburbs under favorable conditions.

Turning westward, the mountains and hill country, dotted with villages, drop off gently into a plain which extends to the blue Mediterranean. The ruins of Cæsarea, which under Roman rule became the most important city and seaport in Palestine, and often connected with the history of the Apostles and the early Church, are visible under favorable conditions; also the orange groves of Jaffa.

Now the sun is soon setting, and we shall have to hurry back to camp if we are to see all the service which commemorates the Exodus from Egypt.

PRAYER POSTURE AND ROBES SIMILAR TO MOSLEMS

As we descend, white-robed figures are seen collecting about the smoking trench-altar. As they slowly gather one by one they spread on the ground small prayer cloths, upon which they stand with bare

THE BURNT OFFERING

All the viscera are emptied of undigested food and then thoroughly salted and with the fat from the inwards and kidneys are placed upon cloven pieces of wood laid across one end of the trench-altar. The burning goes on slowly till the early morning hours.

feet, having discarded their prayer slippers.

While witnessing this ceremony we were impressed by the striking resemblance to the Moslem garb and posture during prayer. The clothing of the Samaritan on this occasion is, in the main, white, the outside garment being a *jubbie* made of muslin, identical in cut with that worn by Mohammedan religious sheiks and by the old-style city Moslems, who happily are not adopting western ideas and modes of clothing. Around a dome-shaped fez the priest winds a white turban, sometimes embroidered in amber silk.

The older men of the laity use the same turban, with the customary flat-topped fez, while the young men and boys, like the Mohammedan youths, wear no turbans and are usually clad in white shirts and drawers. The Samaritans, except when in prayer, wear deep wine-colored turbans, as the result of an edict of one of the caliphs, to distinguish them from their Mohammedan neighbors, for originally they wore white and were often mistaken for Moslem sheiks learned in the Koran. Similarly, the Jews formerly used black as a distinguishing hue.

Before all prayers, the Samaritan goes through prescribed ablutions, washing with water three times each the hands, mouth, nose, face, ears, and feet, in this order, and, like the Moslem, he spreads the prayer cloth, which in some instances has the *mihrab* design.

FACING THE HOLY OF HOLIES

Now all have congregated. The venerable high priest, Yakoub (Jacob), feeble and infirm, clad in a pale-green *jubbie*, takes his place in front of the congregation. The two second priests, Ishak (Isaac) and Tewfik, stand slightly behind the high priest. Then come in rows the elders according to rank. Now all the males of the community are present, the smallest boys lining up at right angles to the foremost ranks.

On every hand the walls and terraces are jammed with onlookers, mostly boys and youths of Nablus.

Facing the holy rock on the crest eastward, the worshipers now bow to the earth in prayer, for the Samaritans always face their Holy of Holies wherever they are.

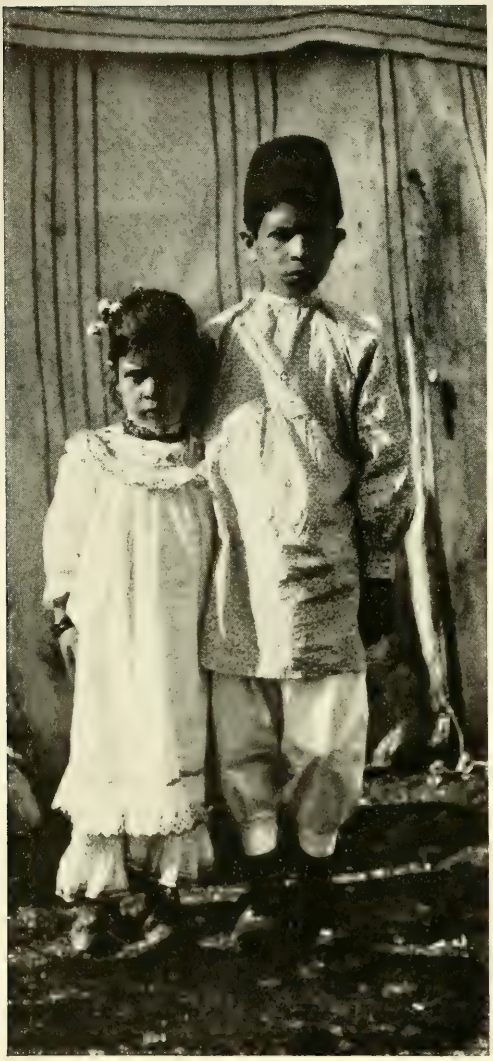
The service begins with a prayer written some seven centuries ago by the priest Hassan el Suri. As it is repeated in concert, the rows of the older men and the priests kneel, or rather sit upon their heels, with hands on the knees or outstretched to heaven whenever any petition is asked. They bow their heads in unison, touching their foreheads to the ground. Some of the younger men standing behind, also with outstretched hands, join in the prayer. Throughout the service it is most interesting to watch the tiny little fellows, each beside his parent, while all follow in the repetition with as much earnestness as the grown-ups and entirely unconscious of their surroundings.

Simultaneously with the beginning of the service the sacrificial lambs have been driven into the inclosure and wander about at will, grazing upon the few tufts of green or treading upon the high priest's prayer rug till driven off.

The prayer is ended with a loud Amen! Whereupon all rise and remain perfectly erect, while in silence they repeat another prayer, called "Akid el Niyeh," a meditation which denotes the consecration of their souls to prayer. It consists of repeating the five articles of their creed—belief in God, in Moses, the Pentateuch, Mount Gerizim, and the Day of Judgment.

This and the story of creation precede all prayers. When ended a hymn is sung in praise of Yahweh, the little fellows stretching their mouths to their utmost capacity, while the older leaders, turning about from time to time, prompt and encourage the others to more fervent utterances. All these prayers, readings, and hymns are, of course, in the Samaritan Hebrew, the oldest form of that language in use.

Next, from the hand-written Pentateuch which each carries, they read in unison 21 selections, in which Abraham, Isaac, and Jacob are mentioned ("in memory of the fathers"). During the reading each time God's name is mentioned the men stroke their beards downward thrice. Likewise whenever passages are recounted enjoining them to remember their God, they bow, swinging the body



BETROTHED

Among the Samaritans, as with most Orientals, the parents of the children arrange the matches. The betrothal often takes place when the bride and bridegroom are mere infants, while early marriages are the rule.

forward from the hips, in token of reverence and submission.

The high priest, who has been facing the crest of Gerizim with the congregation, now turns about and repeats an antiphon, to which the leading men reply, and in conclusion a psalm is sung.

The aged high priest now mounts the fragment of an ancient column and in a low, quavering voice sings a short hymn. With his eyes upon the setting sun, he reads the first twelve verses of the twelfth chapter of Exodus, wherein are given the first commands regarding the observance of the Passover.

KILLING THE SACRIFICE

In the meantime the youths and boys have carried out the lambs and are holding them in a circle about the trench-altar, where the caldrons of water are already boiling.

Over the lambs stand three slaughterers with glistening knives of razor sharpness, for, like the Jews, only those recognized as knowing the laws regarding *kosher* and *taraf* (ritually clean and unclean meat) are allowed to do the killing. As the reading proceeds, it is so arranged that, as the passage "then shall all the convocation of the assembly of Israel slay it between the two evenings" is spoken, at the word "slay," with one deft stroke downward, each of the three slaughterers cuts one throat and jumps to the next.

In a few seconds all have been sacrificed, the white clothing of the boys holding the struggling lambs being much bespattered with blood. Thus the passage "between the evenings" the Samaritans translate to mean between sunset and dark, the twilight hour in these lands being very short. "Thou shalt sacrifice the Passover in the evening, at the going in of the sun, at the very time thou camest forth out of Egypt."

As the slaying commences the great throngs of Samaritans and Gentiles cease to crowd about the priest who is reciting and press around the altar. All is a veritable Babel, with prayers repeated, shouting, singing, and clapping of hands.

The joy exhibited is akin to that of our children on Christmas morning or when around the blazing tree, and reminds one of the light-heartedness of the Jews when celebrating the feast of Purim, commemorating as it does the destruction of their enemy, Haman. During all this excitement some of the little Samaritan girls and boys make their way among the sacrifices, and the latter with their finger ends dot their faces with daubs of the paschal blood.

One of the young priests collects a quantity of the fresh blood in a basin and

with a bunch of wild thyme vigorously stirs it; then rushes away to put a dab of it above each tent door. Upon returning he empties the remainder into the fiery ditch. "And ye shall take a bunch of hyssop, and dip it in the blood that is in the basin and strike the lintel, . . . for the Lord will pass through to smite the Egyptians; and when he seeth the blood upon the lintel the Lord will pass over (Passover) the door, and will not suffer the destroyer to come unto your houses to smite you" (Ex. 12:22, 23).

Incidentally it is of great interest that the thyme is used. Botanists have differed as to what herb the hyssop might be. Here we learn that this wild thyme has properties which keep the blood from coagulating. Besides, this custom having been handed down in unbroken succession, little if any room is left for doubt as to its identity with hyssop.

UNLEAVENED BREAD AND BITTER HERBS

While the lambs are giving their last life struggle, youths pass among the people bearing large trays piled high with bitter herbs, a sort of wild lettuce that grows on Gerizim, rolled in thin sheets of unleavened bread. Rolls are distributed among non-Samaritans as a token of friendship.

As the killing of the lambs commemorates the sacrifice that saved the first-born of the Hebrews from the fate of their Egyptian neighbors, so here also the eating of the bitter herbs and unleavened bread is a reminder of the bitterness of the Egyptian tyranny and the haste with which Israel left the land of the Pharaohs. "And they baked unleavened bread of the dough they brought forth out of Egypt, for it was not leavened; because they were thrust out of Egypt and could not tarry, neither had they prepared for themselves any victuals" (Ex. 12:39).

The bread is identical with that used by the Bedouin and journeying peasants, since the baking apparatus is simple and portable, and quite likely is akin to that used during the Exodus. The loaf resembles a gigantic but very thin pancake, being pliable and not crisp like the "motsis," or unleavened bread used by the Jews at Passover.

At the sacrificial altar the older men and some of the priests, who now stand about those to whom is delegated the task of dressing the lambs, have kept up the reading of the story of the Exodus as far as to Miriam's song of triumph. Meanwhile, as soon as the lambs have become lifeless, boiling water from the caldrons is poured over them, while several boys and men crowd about in the semi-darkness and pluck off the wool instead of skinning the victims, the object being to protect the flesh while roasting in the ground oven.

A SAMARITAN BABY

When photographed, this child was the picture of health. Shortly after, he became ill and the mother always attributed the misfortune to the "evil eye" of the camera or of the photographer.

THE RITUAL INSPECTION

Next the ritual inspection takes place, for as each lamb is fleeced it is suspended

SAMARITANS AT PRAYER ON THE EVE OF THE PILGRIMAGE

During the entire week following the Feast of the Passover, the Samaritans remain encamped upon Mount Gerizim. On the last day of the encampment they begin at dawn a pilgrimage to the crest of the sacred mount. Before setting forth on this pilgrimage, however, the men spread their prayer cloths and repeat the creed and the story of the creation in silence, after which, in a loud voice, they read in unison the Book of Genesis and the first quarter of the Book of Exodus, ending with the story of the Passover and the flight from Egypt.

COLLECTING FOR EVENING PRAYERS ON GERIZIM

Before all prayers the Samaritan observes prescribed ablutions, almost identical with the present customs of the Moslems, and like them he now spreads his prayer cloth.

by its hind legs on a long pole resting on the shoulders of two of the men. The work of removing the offal, the heart, liver, and lungs is done by lantern light. Great care is taken throughout this inspection not to mutilate a bone, for the command "neither shall ye break a bone thereof" is strictly observed. Any carcass found ritually unfit is put on the burning altar and consumed with the offal. This, however, is a rare exception. The last time it happened was some five years ago, when a lamb was found minus a kidney.

Unlike the Jews, who will not eat of the hind quarters of any animal until all the sinews have been entirely removed, the Samaritans claim to know exactly the cord the angel touched while wrestling with Jacob at the ford of the Jabbok, and now a deep incision is made in the flank and it is taken out. "And Jacob was left alone; and there wrestled a man with him. And when he saw that he prevailed not against him, he touched the hollow of his thigh; and the hollow of Jacob's thigh was out of joint. . . . Therefore the children of Israel eat not of the

THE SAMARITANS ASSEMBLED UPON THE SACRED ROCK

A few of the devout members of the congregation do not dare advance to the rock itself because of certain scruples regarding their ablutions. These individuals may be descried in the background kneeling like their brothers on the rock, their faces turned toward the holy spot.

sinew which shrank, which is upon the hollow of the thigh, unto this day" (Gen. 32: 24-32).

Deep gashes are made in the fleshy parts in order that the salt may penetrate, while the right shoulder is cut off to be roasted on a separate spit, being a priestly portion. Pieces of the head are also reserved for the priests. Only the males of the priestly family and women of the same blood, if unmarried into other families, may partake of them. "And this shall be the priest's due from the people, from them that offer a sacrifice, whether it be ox or sheep; and they shall give unto the priests the shoulder and the two cheeks."

Now an oaken spit, the length being slightly greater than the depth of the ground oven, is thrust through each dressed lamb lengthwise, the head hanging downward. To prevent the meat slipping off, a wooden pin is driven through the spit three or four spans above the lower end, and on it rests a cross-board.

As the preparation of each lamb is completed, much salt is rubbed into the flesh. "And every oblation of thy meat offering shalt thou season with salt, neither shalt thou suffer the salt of the covenant of thy God to be lacking from thy meat offering: and with all thy offerings thou shalt offer salt" (Lev. 2: 13).

THE BURNT OFFERING

This mandate is also closely observed in the matter of the burnt offering, for the viscera as collected are emptied of undigested food and then thoroughly salted, and, with the fat from the inwards and the kidneys are placed upon cloven pieces of wood laid across one end of the ditch-altar, and the fuel under it now is ignited from the fire beneath the caldrons. The burning goes on slowly till the early morning hours.

But long before these preparations have been completed the readings have come to an end, while all those at work and the onlookers shout incessantly, "We call and

HANDS OUTSPREAD TO HEAVEN

"And it was so, that when Solomon had made an end of praying all this prayer and supplication unto the Lord, he rose from kneeling on his knees with his hands spread up to heaven." It was then the custom with the Hebrew nation, as still with the small remnant of the Samaritans, to spread forth the hands toward heaven. One object entirely out of harmony with the picturesqueness of this scene is the 20th century steamer chair in the center of the group of worshipers. It appealed to the Samaritans, however, as a convenient resting place for the sacred scroll in preference to the quaint but clumsy wooden stands of the synagogue.

we affirm, there is no God but God." In fact, they aim to keep this up all night, but there are numerous interruptions.

Once the service has come to an end, all those not engaged bow forward and kiss the hand of the high priest, saying in Hebrew, "Every year may you have peace." He in turn gives each his benediction and retires to his tent.

HOW THE MEAT IS COOKED

It is now only about four hours before midnight and the sides of the ground oven are glowing with heat. The white-robed figures, with much shouting and commotion, bring the spits forward, holding them in a circle about the fiery pit. With loud voices they repeat, "Hear O Israel, the Lord our God is one Lord," and passages of Scripture in which they are admonished to observe diligently the law.

Suddenly the spits are simultaneously lowered into the oven and a wickerwork lid made of sticks placed over the top, the spits protruding slightly and so held in place. Grass, sod, and mud, previously collected for the purpose, are placed over this, closely sealing the lid, so that no smoke or steam can escape, and thus extinguishing the fire; but the heat of the stones is sufficient to roast the tender mutton. "Eat not of it raw, nor sodden at all with water, but roast with fire; his head with his legs, and with the purtenance thereof" (Ex. 12:9).

THE EVENING PRAYER

Once these duties are over the men again collect for prayer. It is now well into the night. Beginning, as usual, in silence, with their creed and the repetition of the story of creation, Pentateuch selections pertaining to the Passover and

SAMARITANS BAKING UNLEAVENED BREAD

The bread is made with flour quickly kneaded with water only and baked on a convex disk of sheet-iron. It is identical with that used by the Bedouin and journeying peasants. Since the baking apparatus is so simple and portable, the bread probably is much the same as that used during the Exodus. The loaf resembles a gigantic but very thin pancake.

the patriarchs are read. Between the first selections hymns are sung.

A lengthy rotation now takes place: Joshua's prayer, one that Samaritan tradition asserts he was in the habit of using; singing the song of Moses at the Red Sea, and the "Angel's Song." The main feature, however, is the clothing of the high priest or his representative with a silken cloth. The priest now presents to view one of the ancient Pentateuchs, one in book form, written on parchment.

It is an impressive sight when these white figures in the bright moonlight, kneeling thrice and prostrating themselves to the ground, always toward their Holy of Holies, repeat in unison, "It is a night to be much observed unto the Lord for bringing them out of the land of Egypt; this is that night of the Lord to

be observed of all the children of Israel in their generations."

Thus the three Passover services are ended. The first, before the lambs are slaughtered, is called "Salat el Dabih" (Sacrificial prayers); the next, while the fleecing is taking place, "Salat el Jismeet" (Scalding prayers), and "Salat el Garub" (Sunset prayers). Under ordinary circumstances prayers are always said at even, but since the Passover service is the more important, the evening prayer is unavoidably delayed.

WHERE ARE THE WOMEN?

During the afternoon and the early evening the women have played no rôle in the scene. They have kept to their tents, while those unable to make their ablutions, and therefore prohibited from eating the Passover, are confined in one tent.

Like the older but now passing Jewish and native Christian custom, the Samaritan women do not strictly hide from men, but only veil when on the street and keep out of the way when strangers are present.

The present paper is written after having witnessed the Passover ceremony four times—twice before the great world conflict and twice during it. The first occasion was when the author was a youth, the second in 1914.

On both of those occasions the women were hardly seen, eating their portion of the sacrifice in the tents, some of the little girls alone showing themselves. During the years of the war this phase of the scene materially changed. There were no tourists or professors, with large cork hats and western clothing; no note books and pencils; no inquisitive questions to embarrass the women or to mar the ancient atmosphere of the spectacle.

Once the sacrifice had been slain, the crowds from Nablus, smaller these years than usual, descended and the Samaritans were left alone. In the moonlight there was no sight nor sound foreign to the surroundings to distract one's attention, and the imagination was given rein. The conception wandered back thousands of years, and one only awoke with a start to the reality of living in the twentieth century when a sudden flash of magnesium powder lit up the sky and then left all in deep darkness.

The evening prayers over, some retire to rest in their tents, some pray or read to keep awake, while not a few sit around the smouldering altar watching that every scrap is burned.

No sooner are we left alone with the Samaritans than the women begin to appear. They whose lives are so immersed in small things that they seldom leave their homes, the older women having no education at all, find great pleasure in the freedom of sitting around the sacrificial altar, conversing in their native tongue with Mrs. Whiting, and enthusiastically displaying their babies, awake or asleep, at this late hour.

OPENING THE ROASTING PIT

Thus the three to four hours between putting the lambs to roast and the time of the feast roll quickly by. Incidentally we retire to our tent and dine on roast lamb, killed and prepared by peasants of the neighboring villages in identically the same style as the paschal lambs, except that the skin is removed, for no non-Samaritan is ever allowed to partake of the sacrifice. "And the Lord said to Moses and Aaron, This is the ordinance of the Passover: There shall no stranger eat thereof."

It is because of this injunction that the Samaritans so scrupulously collect and burn any scraps cut away during the inspection, and that the burning altar is so rigorously guarded.

Even after the ceremony is at an end, the ditch and oven are filled with stones lest any remaining charred bone or fragment fall into the possession of a Gentile.

As the midnight hour approaches, the sleepers are awakened by callers and suddenly the camp is again astir. The youths with hands and hoe remove the seal from the oven, and clouds of steam pour out; so that, even with the aid of a lantern, little can be seen. It is interesting to notice the air of hurry, although time is of no consequence. The cover is now lifted with much shouting and screaming, and the same prayer said as when the lambs were placed in the oven. At once the spits are withdrawn and closely guarded while the meat is slipped off, each lamb

WAVING THE SACRED SCROLL, ONE OF THE CEREMONIES DURING THE SAMARITAN PILGRIMAGE TO THE HOLY ROCK, WHICH FOLLOWS THE CELEBRATION OF THE PASSOVER

The high priest, taking the sacred scroll from its resting place, holds it in his arms. Then he raises it over his head and the copper case is unfolded, so that the parchment is exposed toward the devotees, who stroke their faces and beards in reverence.

SAMARITAN PILGRIMS AT PRAYER IN FRONT OF THE HOLY ROCK

During the greater part of the service the high priest with staff in hand stands facing the sacred scroll, which has been placed before the Rock. He leads the congregation in reading.

THE BIBLICAL SALUTATION: PALESTINE

Embracing one another, the head is put on the other's shoulder or neck, the latter being bent forward, and in doing so the cheek or neck is kissed, alternating from one shoulder to the other. "And Esau ran to meet him (Jacob) and embraced him, and fell upon his neck, and kissed him." The Samaritans are the tallest people in Palestine.

into one of the great copper pans, the shoulders being put with the portion for the priestly family and taken to the prayer inclosure, just beyond the still burning altar.

EATING THE MEATS OF THE PASSOVER

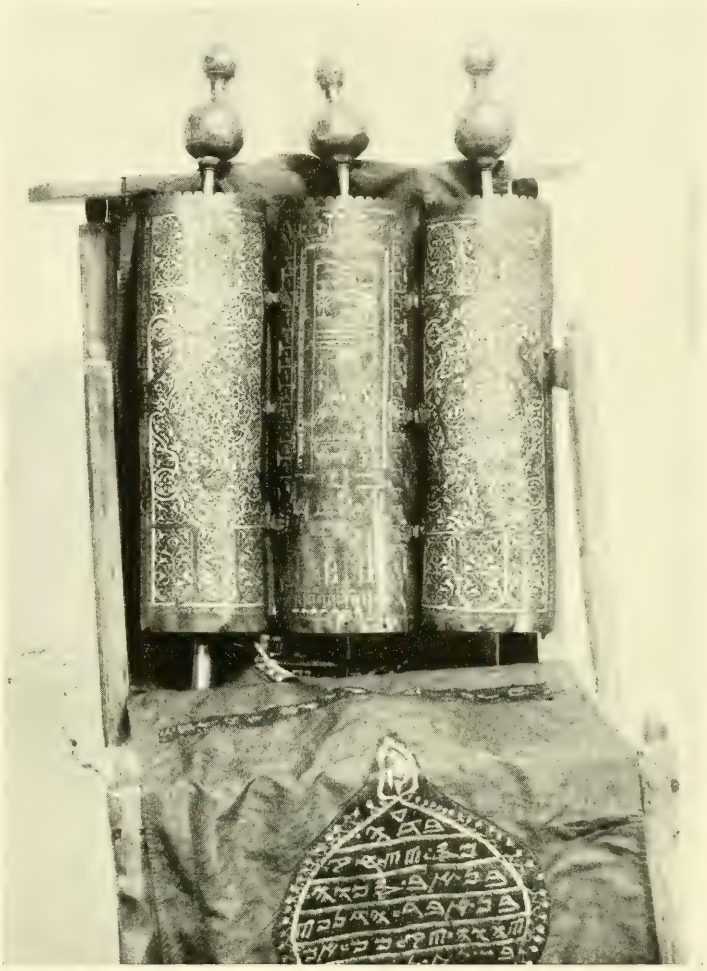
Some of the flesh, being overdone, falls from the spits, and one of the men volunteers to rescue it. Winding bits of sacking about his hands to prevent blistering them, he is lowered into the oven. Quickly the meat is collected in a basket.

Only two men have remained near the pit, and they become so engrossed with the meat basket that the man in the pit is temporarily forgotten. The heat is more than anyone can endure longer than a few seconds, but the shouts of the unfortunate go unheeded until a Gentile sends his fellows to the rescue.

The members of the six Samaritan families have now collected each around one of the lambs—men, women, children, and nursing babies. The elders and the priests arrive, each girded about his

outer clothing, shod and bearing a staff or cane in imitation of the equipment on the flight from Egypt. Now the meat is sprinkled with minced bitter herbs, and straw trays of unleavened bread are placed at hand. The high priest, in the midst, in quavering tones, says: "In the name of God I call, 'Hear O Israel, our God is one God,' " etc., while all voices join in singing an ancient Exodus hymn in which mention is made of the multitudes of Israel that left Egypt as the issue of only seventy souls who went down into that land in the days of Joseph.

Every one now begins to eat ravenously, pulling the meat from the bones with the fingers. No forks or knives are used, and great care is observed not to break a bone. The flesh is consumed quickly, for the devout are truly hungry, having eaten little substantial food during the previous day. "And they shall eat the flesh in that night, roast with fire, and unleavened bread; and with bitter herbs they shall eat it. And thus shall ye eat it: with your loins girdled, your shoes on your feet, and your staff in your hand: and ye shall eat it in haste: it is the Lord's Passover" (Ex. 12 : 8 and 11).



THE SACRED SCROLL OF THE SAMARITANS USED ON GERIZIM (REAR VIEW)

The scroll is contained in a copper case inlaid with silver and gold, with designs representing the temple sacrificial altar, table of shewbread, the golden censer, cup of manna, and other temple furnishings.

Those who are unable to leave their tents because of sickness have a portion sent to them, and, no matter how ill, they always partake of a little. Even the nursing babies have their lips touched with a morsel, all in literal compliance with the command that any one refraining from eating it shall be cut off from Israel.

Within a few minutes the meal is over and the high priest, leaning picturesquely upon his staff, recites a short prayer. Every bit and bone remaining is now collected and taken to the altar. Across the end where the offal has been burned the wickerwork oven cover is now thrown, and upon it all the spits are piled, together with the bones and leavings. A fire is lighted under them. Every person now washes with hot water from the ket-

Drawn by A. H. Bumstead

A MAP OF ASIA MINOR AND THE HOLY LAND

Showing the home cities of the Seven Wise Men of ancient Greece (see the succeeding article) and the land of the Samaritans. (Note, in the small inset map, the relative location of Mount Gerizim and Mount Ebal and the historic cities, ancient and modern, which have clung to their slopes—see text, pages 1–21).

tles, pouring it over his hands from ewers, so that it also flows into the ditch-altar, lest even this infinitesimal quantity of the sacrifice should fail to be destroyed by fire. "And ye shall let nothing of it remain until the morning; and that which remaineth until the morning, ye shall burn with fire" (Ex. 12 : 10).

Thus the sacrifice and ceremony commemorating the Exodus are ended.

Each celebrant now goes to his tent for a few hours' sleep. Early the next morning the congregation again gathers for prayers, the day being observed as a Sabbath: the first day of the feast of unleavened bread.

As the onlooker retires to his tent or descends the path to Nablus in the hush of early morning, the scene, brightly lit by the moon, is one not to be forgotten.

From beyond the camp a great white cloud of smoke curls skyward. Now and then a red flame licks the sky or a white, ghost-like figure adds some fuel. It is a picture which cannot be reproduced with the camera; only to the mind's eye can it be painted. The wood-cuts and steel-engravings found in our old family Bibles, where the Israelitish camps are shown with the pillar of cloud and fire, come nearest the present reality, but are lacking in color and atmosphere.

As we turn for one last glance at the moon-lit camp and the redder glow of the flame with the pillar of smoke, we cannot but realize that here we have seen the eating and burning of the last Hebrew blood sacrifice, and there comes the thought that it may never be seen again, for the Samaritans are a dying people.

ASIA MINOR IN THE TIME OF THE SEVEN WISE MEN

By Mary Mills Patrick

President of the American College for Girls, Constantinople

ASIA MINOR was the home of the Seven Wise Men, with some exceptions. There is great disagreement among ancient authorities as to who all of the Seven Wise Men really were, and only four of them are the same in all the lists given.

The four about whom we are sure are Bias of Priene, Pittakos of Mitylene, Thales of Miletus, and Solon of Athens, and three of these four were from places on the eastern Mediterranean. (See map of Asia Minor on opposite page.)

Even if we take the whole list of the seven as they are sometimes given, four of them were from Asia Minor or the Ægean Islands, and only three from Greece proper. Furthermore, Solon of Athens, the most important of those from Greece, appears to have greatly enjoyed traveling in the provinces of Asia Minor, for in regard to his journeys in the East we have many stories, both true and false.

One familiar story concerns his visit to Crœsus, the richest of the kings of Sardis. After his royal host had shown him all the glory of the court and the treasures of silver and gold, Solon was asked whom he considered the most fortunate man in the world, the expectation, of course, being that the Wise Man would name the great and powerful Crœsus as the most fortunate individual who had ever existed.

Solon, to the king's surprise, however, named certain obscure people who had done their duty and were loved by their neighbors and afterward died the death of simple but honored citizens.

A TALE DESTROYED BY HISTORICAL CRITICISM

The noble words of Solon had a great effect on Crœsus, and were remembered at the tragic moment when Cyrus was just about to burn him to death, and were the means of saving his life.

We all know this story, but, unfortunately, it can not be true, for Solon would have been too old and Crœsus too young for any time of meeting to have been possible; and so we must yield this delightful tale, with many others, to the destruction of historical criticism.

Another story which connects Solon with the East may be genuine, as far as its chronology is concerned. It is said that the great law giver, hearing his nephew singing one day, asked him who was the author of the song. The youth replied that it was one of Sappho's poems; and Solon was so much impressed with its beauty that he exclaimed, with admiration, "Let me not die before I have learned it."

PICTURING THE HOME LIFE OF ASIA MINOR 2,500 YEARS AGO

The centers of interest and activity among the Greeks at the time of the Seven Wise Men were in Asia Minor, and such familiar names as Samos, Chios, Miletus, Mitylene, Smyrna, and many others were connected with the great events that occupied the minds of the people in that era.

All who are familiar with the scenes of the eastern Mediterranean love them and enjoy reproducing the history of their past, reviving the descriptions of the busy life that came and went from one generation to another in those surroundings.

We may study with interest Asia Minor under the Roman occupation, at the time of St. Paul; or we may go farther back, to the period of the Kings of Pergamus; or we may try to picture the life of the eastern Mediterranean in the

ARRIVING AT AN ASIA MINOR MARKET-PLACE

Why it should be considered an insult to call a man a donkey cannot be understood by those who know life in the Near East, for the patient, sure-footed, dependable little beast of burden has as many virtues as he has duties. Though the ways in which they are employed differ greatly, the caravan master would feel as much at a loss without his donkey as would the Scotch shepherd without his collie.

Photographs from Mary Mills Patrick

THE CITY OF MITYLENE HAS GIVEN ITS NAME TO THE ISLAND WHICH WAS THE HOME OF SAPPHO

Lesbos, as the little island of Mitylene was called until the Middle Ages, was the home of the Æolian school of lyric poetry. Beauty and profligacy were the main attributes of the Lesbian women, but neither characterizes the present inhabitants.

GREEK PEASANTS DANCING ON THE HILLS NEAR EPHESUS

These lineal descendants of the Greeks of ancient days have retained much of the grace and appreciation of rhythm which distinguished the race in the time of the Seven Wise Men, when a knowledge of music and poetry was universal in Greece, the islands of the Ægean, and the Ionian colonies of Asia Minor.

Photographs by Cass Arthur Reed

DONKEY AND CAMEL BOY ARE THE PACE-SETTERS FOR THE NEAR EASTERN CARAVAN

The camel is too dull a creature to be without a leader, so the donkey leads the long line of patient beasts of burden. The paving here seen is exceptionally fine for Asia Minor, but when wet and slippery it offers an insecure footing.

RUINS AT LAODICEA, CITY OF ONE OF THE SEVEN CHURCHES OF THE APOCALYPSE

Ephesus, Smyrna, Pergamos, Thyatira, Sardis, Philadelphia, and Laodicea are well known to students of Revelation. The Laodiceans were lukewarm in their belief and were so self-satisfied in their material wealth that Paul censured them severely. This fine city, named for the wife of Antiochus II, suffered at the hands of Timur the Lame and was repeatedly damaged by earthquakes.

Photographs from Mary Mills Patrick

GUZELHISSAR, MEANING BEAUTIFUL TOWERS, IS THE TURKISH NAME FOR ANCIENT TRALLES, WHOSE RUINS ARE TO BE FOUND EIGHT MILES FROM THE BANKS OF THE MÆANDER RIVER

The town, which is found on English maps as Aidin, sits astride the Eudon, an affluent of the historic Mæander. The tanning of morocco leather and the export of cotton and figs are the chief industries, but to the epicure of Turkey the city is famous for its sweetmeats. Tralles was once the strongest fortress in the broad valley of the winding river from which we derive the word "meander."

even earlier period of the Seven Wise Men, which was from 650–550 B. C. It was a time of unique interest in history, for much of our present thought-life owes its origin to movements which began in the days of the Wise Men.

Can we put ourselves back in that far-away time and picture something of the homely, every-day life of the people? Can we find out how they thought and felt?

What we wish is not the historical facts about that age, nor the translation of the writings that have come down to us from it, but the human living, which was the *cause* of the history and of the literature,—something which books cannot give us—a comprehension of the throbbing, pulsing life that was strong and vivid enough to make itself felt, even to the present time.

THE CHARM OF ISLAND LIFE IN THE ÆGEAN

The outward surroundings we can reproduce, for they are still practically the same. The eastern Mediterranean is one of the gardens of the world. The sea is bluer than other seas; the tints of the skies are softer, the violet and rose blend more marvelously in the sunsets, the mountains have a sensuous attraction, and the sails on the horizon allure.

There is a wonderful charm also in the island life of the Ægean, and that charm must be in many ways the same at the present time as it was in the distant age of which we are speaking.

Other parts of the world have changed under the transforming power of modern enterprise, but the shores and islands of of the Ægean have thus far largely escaped the influence of modern business life. As yet, no sky-scrapers nor commercial storehouses, few railroads, automobiles, and electric trolleys mar the effect with their harsh lines and shrill sounds.

The calm and peace of country scenes have remained, and in their natural features we may still find the surroundings of the old life, for the environment of the new scenes gives us the probable setting of the old.

The shipping also has not wholly lost its ancient form. It is true that the picturesque warships, with their banks of oars each side, have disappeared; but the craft which lazily sail from one port to another today may well remind us of the descriptions of the old merchant vessels.

ALWAYS THE SEA FOR REFUGE

A great wave of colonization had passed over that part of the world just before the time of the Wise Men, and the colonies, after the struggle for existence of the early years in new surroundings, had emerged into a larger life. In finding larger life the sea always helped them; for, in political strife within and the need of protection from without, there was always the sea for refuge. People who can sail away from trouble at home always find resources, and the sea was the source of many treasures.

The growth of the colonies was rapid, for other reasons. How could it be otherwise in such beautiful and fruitful surroundings! As Herodotus says, "The Ionians built their cities under the finest sky and in the finest climate in the world, for neither the regions above nor below nor the parts to the East or West are at all equal to Ionia."

IONIA THE CENTER OF THE WORLD'S COMMERCIAL LIFE

People of the twentieth century look to England and the United States as among the countries where the comforts of living and opportunities of learning how to do things are very great, but men went to Ionia, in Asia Minor, for these advantages in the age of the Wise Men.

To be up to date at that time one had to live in Ionia, where life was luxurious. There, things were produced richly with little effort; grapes were abundant and the wine the best in the world, and ships laden with olives and wine and oil sailed to all ports of the Mediterranean—Egypt and Phœnicia, Italy and Northern Africa, and even as far west as Spain—bringing back the luxuries of other lands.

Long before Athens joined the circle of commercial cities, the riches of the entire eastern world were represented in Ionia. The market-place in both large and small towns was the central point and constituted a kind of bourse—in fact,

MOSLEM LOUNGERS IN FRONT OF A COFFEE-HOUSE IN AN ASIA MINOR TOWN

Since the Turks took possession of Asia Minor, in the fifteenth century, it has been known as Anatolia, a word derived from the Greek meaning "rising" or "East." It comprises the entire peninsula which forms the western extremity of Asia lying between the Black Sea on the north and the Mediterranean on the south. Its total area is about twice that of the State of Colorado.

Photographs by Cass Arthur Reed

BESDEGUMA, A VILLAGE IN THE AIDIN VILAYET OF ASIA MINOR, WHICH IS SELDOM VISITED BY STRANGERS

Even in remote districts the camera is recognized and the ordinary business of the town is suspended while the strutting braves "have their picture took." The coffee-house is the Turk's café and club, and even in the busy season muleteers and laborers take time to gossip and drink the thick black coffee which takes the place of alcoholic beverages.

Photograph from Mary Mills Patrick

MILKING A GOAT OUTSIDE A CUSTOMER'S HOUSE

A goat can thrive where cattle would starve and sheep would hunger. Europeans believe that goat milk, if used unboiled, will cause Malta fever, but the Asia Minor natives drink it fresh and warm.

was the Wall Street of the town—where the excitement of trade ran so high that a market-master was necessary to control it.

THE FIRST COINS

The question naturally arises: "How was business carried on, by barter or by some primitive kind of banking system?"

Our chief testimony on this point is furnished by the coins of the period, for coinage originated in Asia Minor, and as early as the time of the Wise Men coins were in common use. There are very few specimens of that age now in existence, yet some are preserved in the British Museum and in other collections.

The first coins were made of electrum, which is a mixture of gold and silver and which was found in natural form in the mountains of Lydia. There were no inscriptions on them, but emblems of religious worship and also of trade. The connection of the coins with religion may have been because everything in that time was associated with religion. Possibly the priests in the temples were the first to invent coins. On the other hand, the association may simply indicate that the two things about which the people cared most were religion and trade.

Of this type the coin of Cyzicus, on the Marmora, is well known. It bears the figure of a tunny fish decorated with a sacrificial fillet. The great trade of Cyzicus at that time was in tunny fish, which belongs to the mackerel family and is found in the Sea of Marmora. The fillet expressed the religious acknowledgment.

The coins were very primitive in appearance and irregular in shape, some round and some oblong, and all of them much thicker than coins of a later day.

HOW THE CULTURE OF A PAST AGE IS STUDIED

The age of the Wise Men was an age of a certain type of culture. There are two conditions necessary for culture: one is freedom, and the other is a fair degree of material comfort. As Homer says in the Odyssey:

Photograph by Ernest L. Harris

FOUR YOUNG ADALIANS AND THEIR PLAYMATE

Just as Smyrna is the center of Greek hopes for influence in Asia Minor, Adalia is the city where Italian ambitions find expression. Adalia is the most picturesque city on the southern coast of Anatolia and many of its buildings are richly ornamented. There is a small inner harbor and a larger outer harbor, both of which at one time could be closed with chains.

The heaven-taught poet and the enchanting strain,
These are the products of a peaceful reign.

For some of the successful people of Ionia, pleasure consisted in the possession of objects of oriental luxury, in pomp and in the lazy idleness to which the Eastern climate always tempts us; but for those who cared to attain to higher things, the opportunity came in the spirit being free from sordid care and from the pressure of daily need, with leisure to think.

The culture of the age depended, however, not only upon economic causes, but also to a large degree upon the inspiration given by intercourse with other nations, bringing about exchange of ideas and increased knowledge.

The age of the Wise Men was before

the time of Greek history, and there are few records from which to reproduce it. In trying to describe the culture of an age wholly different from anything which we have ever known, the chief authority is from internal evidence of writings of the time, largely poetry, which now exist for the most part in fragments, quoted by later writers, and also from pictures or vases belonging to that period.

The pictorial representations on the vases of the stories of the gods reproduce the ordinary customs of daily life in regard to religious worship, dress, use of chariots and horses, weapons of war, varieties of musical instruments, habits of sitting and standing, wedding and funeral ceremonies, and many other things.

Are we justified in calling the period a cultured one?

It seems to me that we are justified in attributing culture to people who could produce and enjoy the best lyric poetry which the world has ever known, and who could originate lines of thinking that have had a permanent significance in the development of the intellectual life of later times.

Emerson says that the flower of civilization is the finished man, the man of sense, of grace, of accomplishment and social power, and of such there were many in that age.

We find in the late seventh and sixth centuries B. C. the beginning of modern systematic knowledge, and a careful study of the thought of the time will give us an insight into the origin of modern science and philosophy, for our present use of language and our ideas of the world are permeated with the results of that ancient thinking.

Even the emancipation from traditions and the desire for independent individual thought, which characterize modern ideals, find their counterparts in the age of the Wise Men.

ANCIENT CULTURE WAS ADDRESSED TO THE EARS

The culture that arose in Ionia was very different in its form, however, from any development of later times, and most difficult for us to understand.

It was, first of all, addressed to the ears and not to the eyes. We are now essentially an eye-minded people, and measure our learning by the books that we read and write and collect in libraries and by other things that we can see with our eyes, but the sixth century B. C. was an age without any free distribution of written records and only the beginnings of libraries, which were mostly collections of wooden tablets. Some of the great men of the latter part of the period each wrote a book, but it was a laborious process.

Heraclitus of Ephesus was one of those who wrote a book which was kept for safety in the Temple of Diana at Ephesus; for a book was not a thing to be lightly regarded, and the process of writing was so difficult that it was far easier to remember what one had written than to decipher it from the book.

Solon and Pittakos wrote their laws on wooden tablets. However, they did not write them for general circulation among their friends, but rather to preserve the laws that they had promulgated.

LABORIOUS TO WRITE, WRITING DIFFICULT TO READ

Greek writing at the time of the Wise Men was not easy to read, for neither the words nor the sentences were divided from each other, and the lines ran both from right to left and from left to right.

The length of time which archeologists, even when they are good Greek scholars, give to puzzling out inscriptions which belong to that period would not lead us to suppose that any writing of the time would form easy reading for an evening by the fireside or an afternoon siesta.

During the period of the Wise Men, however, writing was becoming more common, as it was in that age that we had the beginning of Greek prose; and while it is easy to conceive of poetry being communicated from one generation to another by constant repetition, it would not be the same with prose, at least in the case of prose that followed any consecutive train of thought.

There were certain forms of prose, however, in the age of the Wise Men that could be easily remembered, such as the so-called gnomic sayings, which were

Photograph from Mary Mills Patrick

AN OLD TURKISH BRIDGE NEAR BRUSA

The silting up of the river beds in the Near East shows the deplorable effects of deforestation.

Photograph by Cass Arthur Reed

THE CARRIAGE, THE CAMEL TRAIN, THE GREEK PRIEST SEATED SERENELY ASTRIDE A DIMINUTIVE DONKEY, AND THE PEDESTRIANS ARE ALL TYPICAL OF MODERN SMYRNA

This city, like six others of Greece, the Ægean archipelago, and Asia Minor, lays claim to the distinction of being Homer's birthplace. The poet was once worshiped here in a magnificent building known as the Homereum.

mostly proverbs, and also fables. Æsop and his fables belong to that era, although Æsop himself, who is one of our most precious literary heroes, is, I regret to say, tottering somewhat under the attacks of historical criticism.

HOW GREEK POETRY WAS PRESERVED

Culture was certainly not measured by book-learning, but every educated man or woman had to be ready with his lyre, when called upon after dinner, to accompany an improvisation, which might be good or bad, according to his ability. If he could not improvise, he repeated some of the wonderful poetry which was the inheritance of the age, for the highest expression of the culture of the time was in its poetry.

The older epic poetry and the lyric poetry of the era of the Wise Men would furnish the means of culture to any age. There was a freshness in the thought and delicacy in the use of words in the Greek lyrics different from anything found in later literature, and it is in the poetry that we find the real soul of the age. Many fragments of it have been preserved, not by any special effort at the time, but because it was a part of the life of the people and must live.

Greek lyrics were the result of many generations of poetical and musical expression, and they show the real creative work of the era and furnish us with the most subtle refinement of word pictures that the world has ever known.

Musical and poetical contests were common, in which the music and poetry were given together and depended on each other for the complete effect desired, and it is difficult to know which was the more important, the music or the poetry.

We are familiar in classic study with the names of many of the great lyric poets of that period, but they themselves were as frequently called musicians as poets. For instance, the poet Alkaïos had the reputation of being one of the greatest musicians who had ever lived.

A profound moral and physical influence was attributed to music. Good music was considered to have the power to reform the character and to heal disease, and to interpret poetry and make it intelligible to the inner nature. The art of music was, therefore, one of the finest things in the education of that time. It was much simpler than the music of modern times and was entirely subordinate to the words sung or repeated.

The charm of the music of this age seems to have been partly in the extreme precision of rhythmic treatment and in a protracted dwelling of the voice on one syllable. When the words which the music accompanied were improvised, the improvising took place under definite rules, and the learning of these rules formed the most important part of the education of a poet.

To the reciting and the music there was also added a rhythmic motion of the body, so that the entire personality of the performer was absorbed in the attempt to express the thought of the poem. The music was constant though subordinate, and the whole performance produced effects of which the most melodious of modern poets could never dream.

MANY MUSICAL INSTRUMENTS

There were many kinds of musical instruments, but the cithara and the lyre were the ones commonly used in accompanying poetry, while the flute was played by both men and women, in furnishing martial music to the soldiers in time of war. Musical bands marched to war with the soldiers and played on flutes, pipes, and harps.

For private use, the lyre and the harp were preferred, for it was thought that they did not prevent one from remaining master of himself—a free and thinking man or woman—while the flute, pipe, or clarinet put the man beside himself and obscured reason.

There is a story of a harpist which might belong to any age. He started a school in which to teach harp-playing He had in his school nine statues of the nine muses and one of Apollo, but only two pupils. When some one asked him, however, how many pupils he had, he said: "Gods and all, twelve!"

There were extensive choirs, whose music was distinctly connected with the religious life of the people. These choirs were composed of both men and women

Photograph from Mary Mills Patrick

PEASANTS ON THEIR WAY TO BRUSA: IN THE BACKGROUND LOOMS ASIATIC MOUNT OLYMPUS

Brusa is the capital of a rich vilayet, which extends from the Sea of Marmora to Afiun-Karahissar, and has been suggested as the government center for the new Turkey. The entire Brusa district has great mineral wealth, immense forests, rich agricultural regions, and valuable industries. Brusa is connected with its port, Mudania, by a railway as well as a carriage road and is a city picturesquely situated, unusually clean, and of extraordinary historic interest.

Photograph from Mary Mills Patrick

AYASOULOUK, THE VILLAGE THAT STANDS WHERE PROUD EPHESUS ONCE RAISED ITS MARBLE BUILDINGS. THE POOL OF WATER IN THE RIGHT FOREGROUND COVERS THE SITE OF THE TEMPLE OF DIANA, ONE OF THE SEVEN WONDERS OF THE ANCIENT WORLD

"How are the mighty fallen!" is the favorite expression of the tourist to Anatolia. Hittite, Phrygian, Lydian—all once great—where are they now? Geography in Asia Minor has long waged war against permanency. There is no great navigable river carrying traders or soldiers into the interior. The central plateau has few approaches and a far different climate from the coastal plains. But the locomotive, the motor truck, and the airplane will soon open up Anatolia in a totally new way, binding it to the world commercially, politically, and geographically, as the historic bridge-land between East and West.

Photograph from Mary Mills Patrick

A PANORAMA OF SMYRNA SHOWING POLYCARP'S TOMB (WHERE THE TALL CYPRESS NOW STANDS)

Polycarp was Bishop of Smyrna and one of the most illustrious of the early Christian martyrs. Upon being led into the theater to be burned to death, he was offered his freedom if he would "revile Christ." To this proposal he made the famous reply, "Eighty and six years have I served Him, and He hath done me no wrong. How can I then speak evil of my King, who hath saved me!"

and were employed for public and private religious festivals—to celebrate, perhaps, a victory, a death, a holy day, a birth, or a marriage. We are told that Alkman, who lived as early as 650 B. C., wrote a choir song for girls which was a dramatic part song.

RHAPSODISTS PRECEDED DRAMATISTS AND ACTORS

There was, however, no drama strictly speaking; the place which the drama subsequently occupied was filled by the rhapsodists. A rhapsodist was one who sang professionally or intoned to music the poems of his age and of earlier ages. For this purpose some part of the so-called Homeric poems was usually selected, an introduction and some closing words added, and it was presented to companies of people in private houses.

A professional rhapsodist would naturally choose the most popular parts of Homer; but if he were a man of some thought power, he might present his own compositions, although that would happen more rarely.

Whenever a banquet was given, the best rhapsodist to be procured was engaged, one who could recite not only Homeric poems, but those of Hesiod and Archilochus, not neglecting the lyric composers of his own time.

In this way the best of the world's poetry became a part of the familiar thinking of the common people, and it was surely a much easier and pleasanter way of learning than through studying from books. There were so many rhapsodists in the latter part of the period that they were organized into guilds and schools.

PREPARATIONS FOR A BANQUET

The room in the house which was used for entertaining was usually rather large, with an earthen floor, which was carefully swept before a feast was given. Before the guests arrived, the hosts and hostesses washed their hands and the goblets were all rinsed. In the center of the room stood an altar, which was covered with wreaths of flowers. The large wine bowl was filled to the brim.

The guests arrived wearing crowns of flowers, and the wine-cup, with wine and water, usually mixed half and half, was passed around, but not before libations were poured upon the ground for the gods.

There was very free use of many kinds of ointments and perfumes, some of which were very costly, made from all kinds of flowers. As a poet of the age writes:

> From the slender vase
> A willing youth presents to each in turn
> A sweet and costly perfume.

Honey and cheese were given the place of honor among the refreshments. The house resounded with music and song.

Now the rhapsodist enters, wearing his white robe and golden crown. There is a man or woman with him who also wears a crown and who sings or plays a low accompaniment to the poetry which the rhapsodist recites.

He begins, perhaps, with selections from Homer, whose poems always had first place in the literary life of the day, and then follow some of the lyric poems of Terpander and Archilochos, Sappho, and others. He naturally selects the poet that belongs to the place where the feast is given.

In Lesbos one would sing of Terpander, Alkaios, or Sappho, and in Paros of Archilochos, and in Smyrna or Chios of Homer.

WOMEN SHARED IN ALL CIVIC ACTIVITIES

Social life in Ionia and the islands was the life of men and women together, for women were free in that age to share in all the activities, even in public athletic exercises in the gymnasium of the town, as we read of their doing in the Island of Chios.

There were, to be sure, no suffragettes, for formal voting by citizens of any class was a thing of later times, but the life of all was free and open and natural, and the standards of morality were much higher than in subsequent periods of Greek history. It is to the corruption of later times that we owe the calumnies that injured the fame of Sappho, for the free life of the era of the Seven Wise Men was not appreciated by succeeding ages.

Photograph from Mary Mills Patrick

THE NAME OF THIS CITY OF ASIA MINOR IS MOST APPROPRIATE—AFIUN-KARAHISSAR, WHICH MEANS BLACK CASTLE OF OPIUM

Situated at the junction of railroad lines leading from Constantinople and Smyrna to Konieh, Afiun-Karahissar, with a population of 20,000 before the World War, has numerous mosques, baths, chapels, and inns, as well as manufactures of felt, carpets, arms, and saddlery; but its chief industry is its opium trade.

Photograph from Mary Mills Patrick

TURKISH PEASANTS GATHERING OPIUM IN THE POPPY FIELDS NEAR AFIUN-KARAHISSAR

The opium poppy is probably indigenous to southern Europe, but it has been introduced into many countries. The Moslems fostered its spread through India, and the Arabs carried it to China. The opium-gatherers in the illustration are scraping the capsule pods to collect the juice which oozes from the incisions made the previous afternoon. The flowers, which fade in a few hours, vary in color from white to a deep violet. The medicinal qualities of the opium poppy have been known since the days of ancient Greece. Theophrastus, the famous pupil of Plato and of Aristotle, wrote of its value.

Celebrations, whether public or private, to be sufficiently distinguished, demanded something new—a new poem, new music, new dance motions. Thus arose the professional schools of the time, where girls and women were taught to write poetry and music. The best known of these was the School of Sappho at Mitylene, although there were many others—two others even in Mitylene.

Sappho's school was in a house in the city, and young women came from all that part of the world to attend it. We know the name of one girl who came from Greece itself to join this school. They were taught the rules of poetry, and to compose music and poetry, for the life of the people called for new music and new poetry almost every day.

There was a great demand also for new hymns to the gods, as each town wished to surpass the others in its festivals, and each great victory in war or celebration of some local event depended for success on the poetry and music of the occasion.

In time of peace, wedding songs were constantly needed, as every bridegroom then, doubtless, as at the present time, considered his own bride the most beautiful of all living women, and desired to provide the newest and the best poetry for the nuptial ceremony. Thus it came about that the wedding songs written by Sappho were among the most beautiful of her poems.

These early schools for music and poetry, which provided for the artistic needs of the people, seem to have existed before any school of philosophy was known.

THE FIRST SCHOOL OF PHILOSOPHY

The first school of philosophy was established in Miletus by Thales, one of the Wise Men, and was quite a remarkable institution, exerting an influence for more than a century.

Thales seems to have given himself more entirely to this school than to any of his other undertakings. There is a legend that he never married, and when his mother pressed him to do so he said: "It is not yet time." After his youth was passed she again urged him to marry and he said: "It is no longer time."

Many of the subjects taught in his school, such as astronomy, geometry, and geography, show the influence of Egypt and Phœnicia; but the philosophy was probably an original product, for while some of the sciences were somewhat advanced, the philosophy was apparently a first attempt at an explanation of the origin of the world. It originated a movement which culminated more than a century later in the idealism of Plato.

We may perhaps understand something of the attitude of the common people toward Thales' School of Philosophy from the story of the old woman who laughed when the master fell backward into a ditch after gazing too long at the stars. The old woman not only laughed, but she is said to have called after him: "If you cannot see what is under your feet, how can you understand what is in heaven?"

GEOGRAPHY AND ASTRONOMY WERE THEN PRIMITIVE STUDIES

The geography and astronomy taught in this school were very primitive: The earth was flat; the sun circled around it horizontally, being concealed at night by high hills. One writer of the time describes the world in the following poetical way: "God makes a mantle, large and fair, and embroiders on it earth and ocean and ocean's dwellings."

It is probable that the schools of the eastern Mediterranean possessed an ancient form of charter which consecrated them to the purpose of learning and prevented interference in their activities by the city.

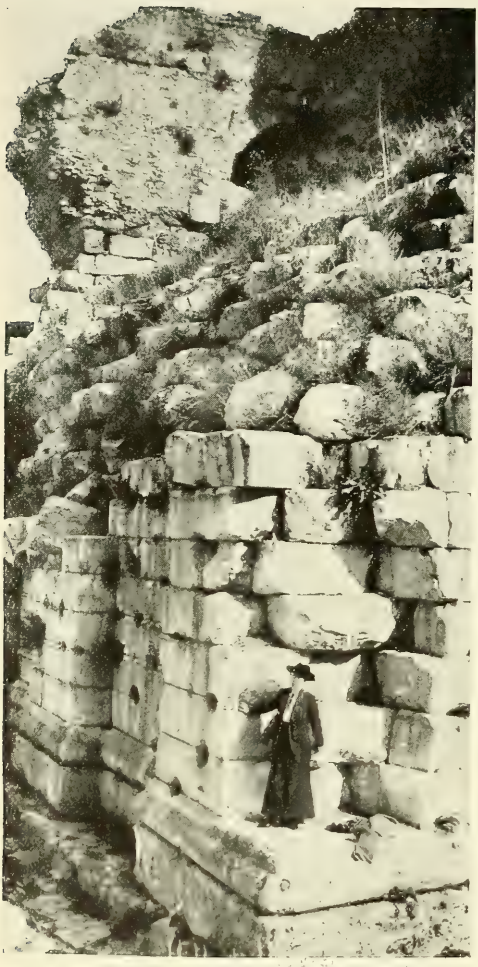
In their charter, some god was selected for the patron deity, and his statue would be the first thing seen on entering the school building or the grounds. Sacrifices were offered to this particular deity, and processions and banquets were made in his honor and holidays were given on his feast days. Frequently some of the goddesses or muses were selected, for one of the poets says: "Loud crying is not fitting in a house dedicated to the muses."

This form of charter was called a *thiasos*, and is fully described in later times in connection with the schools of Athens. The strongest reason for be-

Photograph by George M. Kyrpie

WATER-CARRYING HAS ITS COMPENSATIONS IN THE NEAR EAST, FOR IT FOSTERS SOCIAL INTERCOURSE AMONG THE WOMEN

At times thirty or forty women may be seen discussing for hours the news of the day at such a fountain.



Photograph by Cass Arthur Reed

THE GREAT MARBLE BLOCKS JUST OUTSIDE THE THEATER AT EPHESUS SHOW HOW SPLENDIDLY THE CITY WAS BUILT

At Ephesus the Phœnicians introduced the religious cult of their moon goddess, protectress of trade. The temple was defended by armed virgins, and when the Greeks under Androclus met the fierce resistance of these women warriors the world gained the legend of the Amazons. The supremacy of the heathen goddess was unchallenged until Paul preached the gospel which caused Demetrius, the idol-maker, to fear that his profession would be harmed by such doctrines.

lieving that the custom of the *thiasos* existed in such an early age is the subtlety and force with which religious thought penetrated all the life of the period.

There seems to have been a shrine at almost every turn of the mountain path and a religious ceremony for every act of daily life. There were spirits in every wood and stream and spring.

The people thought of their religion in connection with every event and always consulted the oracle whenever they undertook anything new. The oracle that they honored most was far away at Delphi, in Greece, and before going to war, or building a town, or forming an alliance, a messenger was sent there to ask advice of the oracle.

Delphi held the imagination as the place where the gods spoke to men, inspiring the priestesses with divine words. Yet I fancy that when feeling ran high the people did not always wait to send a messenger to Delphi, which would be a matter of several weeks at least. Probably they often acted without the authority of the oracle and then secured it afterward.

People visited Delphi, however, from all parts of the Grecian world to get advice, and the place became not only a kind of inspiration bureau, but also a bureau of information, for the priestesses saw and talked with people from many places and became very wise in the political affairs of their time and often were able to give extremely good advice.

Their influence was felt all through the Greek colonies, and one of them, Themistoclea, is said to have been the teacher of Pythagoras.

THE DELPHIC ORACLE AS A GREAT DEPOSITORY OF WEALTH

The oracle did not, however, send advice free of payment. Rich presents were expected in return, and Delphi became a kind of national banking-house for the cities of Ionia, with different treasuries to contain offerings from the different places. Gifts of every form and degree of value were sent there—iron spits on which to roast oxen used in the sacrifices; bowls of gold and silver, and all kinds of the choicest treasures of the richest cities.

When the sayings of the oracle failed to prove true, however, complaints were sometimes made, and the priestess would be obliged to justify herself. So it was usually found wiser to be rather noncommittal and to give commands that

could be carried out in more than one way; to send an inscrutable answer, that sounded deep and wise and would allow those who sent to consult the oracle the privilege of doing their own way.

Yet the power of the oracle was almost unlimited and controlled even the rights of kings in the most distant parts of the Grecian world.

There was, however, another side to the religious life of that time more difficult to understand. During the sixth century B. C. there arose a great wave of religious emotions, affecting every oracle and popular temple and influencing even some of the philosophical teaching. It seemed to appear first as an outburst of personal miracle-working in connection with the worship of Dionysus and was especially strong in Asia Minor.

It taught the purging of sin by sacrifice, the immortality and divinity of the soul, eternal reward to the pure, beyond the grave, and retribution to the impure, the pure being those initiated into these teachings. This was the religion of the common people and was closely connected with the Orphic mysteries which were practiced in secret, took the form of secret societies, and therefore are almost impossible to investigate.

THE BELIEF IN INCARNATION

Certain of these cults believed in the incarnation and suffering of Dionysus Zagreus. Zagreus was a god who was born again as a man, yet was a god, was received into heaven, and became the highest and, in a sense, the only god. An individual who worshiped Dionysus Zagreus could himself develop his potential divinity.

Dionysus was explained in the Orphic mysteries as the god within the spirit of worship, as inexplicable joy, as the personification of the spirit of ecstacy, and the impulse above reason that lifts man out of himself and gives him power and blessedness. These mysteries were in part dependent upon the singing and playing of sacred music.

In the time of the Wise Men many of the old temples were rising on the coast of Asia Minor. The Temple of Diana of Ephesus, one column of which is now in the British Museum, was begun.

There is also to be seen in the British Museum a lion of colossal size from Miletus, carved in marble, on which the name of Thales, the Wise Man, is inscribed.

Sculpture had been for some time an acknowledged art and figures were made of gold and silver as well as of marble. Iron also was sometimes used for ornaments, as soldering in iron was discovered in that age by a man in Chios.

The pottery was perhaps the most artistic product of the time, and the earliest known vase bearing a Greek inscription, now in the British Museum, was from one of the Ægean Islands. It is ascribed to the early part of the period of the Wise Men.

THE HALLS OF FAME AND HOSPITALITY

The social life was first of all religious, as the worship of the gods and goddesses involved many public and private ceremonies, but there was also public political life in various forms.

In every large city there was a prytaneum, where national heroes were honored and where public feasts were given. Among the cupbearers who served the wine were sons of most noble families. One of Sappho's brothers was a cupbearer in the prytaneum in Mitylene. The prytaneum was the state hearth, where the sacred fire was ever burning, and there was the center of the life of the whole city and of the colonies sent out from that city.

Of the details of the lives of the Wise Men we know very little, and the stories told about them are probably mythical. Bias of Priene is sometimes placed at their head, but Thales and Solon are the best known. Pittakos was a wise reformer and king in Mitylene, and there is one figure of his head in existence which is found in the *Bibliotheque Nationale*, in Paris, on a coin of later date from Mitylene.

The life of each one of them was doubtless thrilling with interest, but the utmost that we can do to revive their activities is to associate the few events that are known with the places which were the theater of their actions and which are also a part of our own surroundings.

A SUMATRAN FREIGHT TRAIN ENTERING THE HIGHLANDS: IN THE BACKGROUND LOOMS SIBAJAK, ONE OF THE NUMEROUS VOLCANOES OF THE ISLAND

Good roads are almost unknown in the central regions of Sumatra, but along both the east and west coasts there are to be found highways such as this, and motor cars no longer arouse the curiosity of the Sumatran natives. There are only about 200 miles of railway in the island.

BY MOTOR THROUGH THE EAST COAST AND BATAK HIGHLANDS OF SUMATRA

By Melvin A. Hall

With Photographs by the Author

A FEW low islands, eventually to be gathered to the shores of the immense mother-island by steadily encroaching alluvial deposit, appeared and dropped from sight in the sultry haze of mid-afternoon as we steamed up the Straits of Malacca. Sumatra itself was never visible, although on the other side of the Straits, to the northeast, the palm-fringed Malayan coast and blue dorsal range of the interior remained all day in view.

But the Sumatran east coast is so low and flat that its long, dark-green outline can seldom be distinguished above the black water before the ship actually approaches its harbor.

It is a swampy, unhealthy coast, formed by the deposits of silt washed down from the mountains in the periodic inundations of an enormous annual rainfall. In this way the whole of the broad plain between mountains and sea, which, behind its mangrove fringe, forms the splendidly rich lands of rubber and tobacco estates, has gradually been built up and is steadily being extended.

The mangrove plays a considerable part in this extension because of its remarkable powers of reproduction. Growing partly in the shallow water of the littoral, these trees spread out a labyrinth of surface roots that act as a framework for the accumulating mud, which in the course of time rises above the surface and forms land.

CURIOUS SIGHTS ON THE RIVER

The ripe seeds of the mangrove do not fall off, but germinate upon the parent tree, growing downward in long, straight shoots. Eventually these drop from their own weight, and, falling upright in the shoal water, sink to the muddy bottom and there take root. Many fall beyond the outer edge of the swamp, and as the process continues more land is formed and the coast-line is gradually pushed farther out into the sea.

The morning after leaving Singapore we sighted the thin, dark line of the shore as the ship steamed in between the closely set bamboo-and-string nets of the Malay coast fishermen. Then the water became the color of pea soup from the river-brought silt of volcanic mountains, and shortly after the first glimpse of Sumatra we crept into Kuala Belawan, one of the mouths of the Deli River, the screw churning up the dirty yellow mud into a frothy trail.

The shallow water and shifting mud-banks of the coast make the location of ports unreliable and frequently necessitate their removal or abandonment after they have once been established.

Although large steamers now dock in the port of Deli, like most other Sumatran ports it is but a broad, mud-colored stream, winding sluggishly through dense equatorial swamps.

The ship ploughed over the bar into the midst of scenery typical of low rivers near the line. Dripping mangroves, with black, snake-like roots, shut in the river's edge, only here and there grudgingly yielding a little space to tiny coconut groves where palm-thatched huts roosted high on piles above the oily water.

A few sampans and narrow dug-out canoes idled along the banks, the fierce rays of the sun reflected from the ripples in their wake and glistening on the bare brown backs of their oarsmen.

Farther up-river a line of high-sterned *praus* from Borneo, gayly colored and carved, regarded the steamer with mistrustful, painted eyes. Their cargoes of Bandjermasin matting for tobacco bales, and *anak kajoe* (poles for tobacco drying), and *atap* for thatching roofs lay piled high around their curious masts,

DRIVING THROUGH A TEAK FOREST NEAR MEDAN, AN IMPORTANT SEAPORT ON THE NORTHEAST COAST OF SUMATRA

Of all the timbers of the world, teak is the most valuable. Its durability is remarkable, rafters in some of the temples of India having served their purpose for more than a thousand years. It is used for shipbuilding and interior paneling and in the manufacture of furniture. It can be easily worked and is susceptible of a high polish. When properly seasoned, it neither cracks, shrinks, nor alters its shape. The teak is not one of the giants of the jungle, however, for it seldom attains a height greater than 150 feet.

one rising upright amidships, the other with a weird forward rake near the sharp-pointed bow. Beyond, the steamer rounded a bend in the river and tied up to the dock, where groups of men in immaculate white suits and white topees awaited its arrival.

LANDING LABOR FOR SUMATRA

While waiting to supervise the unloading of my automobile, I watched all the fourth-class passengers as they were counted, checked off, and landed.

The latter process, however, was so interesting that I did not begrudge the time it required.

All the deck space not reserved for first-cabin passengers was packed with coolies from Batavia and littered with their effects. A considerable number of them had camped in, on, and under my motor—chattering, smoking, combing

DRYING-SHEDS FOR CURING THE FAMOUS SUMATRAN TOBACCO

These atap-thatched buildings are no longer used for tobacco, however, for this plain has been given over to rubber trees, which are being extensively planted nowadays.

each other's hair, tending their babies, and munching little packages of strange food folded up in plantain leaves.

They were contract coolies on their way to labor on the tobacco and rubber estates of Deli and were chiefly Javanese, though a few Bandjarese from Borneo, Klings of southern Indian origin, Malays, and other nationalities appeared among them.

SUMATRA IS THIRTEEN TIMES THE SIZE OF HOLLAND

Sumatra is an immense island, nearly four times the size of Java and thirteen times larger than Holland itself, but its war-decimated population amounts to less than 3,200,000, most of which, for various reasons, is not available for labor. Because of this the island is barely beginning to attract attention, although more favorably situated than Java and richer in natural resources.

"Java is a country of magnificent realization, Sumatra one of great future." In the development of that future practically all the labor has to be imported on short-term contracts. Chiefly it is Chinese, which is expensive; Kling, which is viewed with disfavor by the British Indian Government, or Javanese, which is unwilling to come and does not thrive in the climate.

The tribulations of a labor contractor from the time of collecting his gang to their final safe delivery in Sumatra are legion and, to one disinterested, very amusing.

The Javanese is tractable and physically a fair laborer, but neither very ambitious nor reliable. He likes his feast days, his rice harvesting, his little comforts and luxuries, and is not eager to forego them for the uncertain inducements of foreign lands. But his mind is receptive, and the clever contractor, fortifying it with well-chosen stories of fortunes easily made, belittling the coolie's fears and objections, is often able to secure his contract by the timely offer of a new *sarong* (the chief article of dress worn in the Malay Archipelago) and perhaps a month's wages in advance.

But here the contractor's troubles begin. Unless carefully guarded, the coolie's enthusiasm is very apt to wane, and the moment for departure arrives with

A LITTLE GOSSIP NOW AND THEN IS RELISHED EVEN BY PRIMITIVE WOMEN: AT A KARO-BATAK MARKET

coolie, new *sarong*, and month's wages unaccounted for.

LURING THE JAVANESE COOLIE FROM THE CONTRACTOR

Even when safely gathered on board ship and the coast of Java has been sunk, there remains still to be cleared the intervening port of Singapore. There, in disguise, wily touts for the Malayan coolie brokers smuggle themselves aboard, no matter how vigilant the ship's officers may be, for labor is everywhere in demand. With much astuteness they proceed to poison the minds of the already-frightened Sumatra-bound Javanese.

"*Sumatra?* A country of tigers and ferocious savages who eat nothing but coolies; a cold land, where there is no sun, no rice; where laborers are unpaid, cruelly treated, and whence they rarely return!"

So the tout whispers on, adding terror to their own premonitions, refuting all that the contractor had said, and in the end offering to aid in their immediate escape from the horrible fate in store, to the tempting security of fortune and happiness in the Malay States.

Strict watch is kept over the ship while in Singapore, but scarcely a trip is taken that a few of those under contract are not among the missing when the final count is made. For every one lost the first mate is personally fined, I think about fifty gulden; but if he brings a certain percentage safely to their destination he receives a liberal bonus. Consequently the final checking off is fraught with deep anxiety for all concerned.

STRIKING COLOR EFFECTS IN WOMEN'S ADORNMENTS

Single file, as I watched, the ship-load of coolies passed before me and down the gangway between two officers and a contractor's agent, who checked them as they went—men, women, boys, and girls, with folded mats under their arms and their possessions tied up in long cloths slung around their necks and resting on their hips. Only those with babies were kept apart and counted last, lest one tiny head should be overlooked.

THESE FEMALE PORTERS ARE NOT AS HEAVILY BURDENED AS THEY APPEAR TO BE; THEIR HEAD PACKS CONSIST OF FINE MATTING

They were a picturesque lot in their gay-colored clothes. Most of the women were bareheaded, their black hair brushed back and knotted behind, with strings of coral beads hanging around their necks and big buttons of gold and silver, jade, amber, or ebony extending their pierced ear-lobes. Brilliant scarves half-concealed their fresh white corsages, and leather belts with massive silver buckles encircled *sarongs* of many hues.

Around the heads of nearly all the men were twisted the universal brown kerchiefs of Java flaunting starched corners; and, in addition to their *sarongs* and a few short coats and pajama tops, there was a noticeable partiality for white undershirts and long pink drawers.

Following the others came a tall Punjabi Mohammedan with a long gray beard. His dignified bearing and the striking eyes of the Indian Mussulman, which looked straight out from under an enormous turban, marked him at once as a very different type from his casual Malay brethren.

Two hours more elapsed before the next landing party, ourselves and the car, finally left the ship. The dock was many feet below the deck and the spaces in which the car had to be turned were all shorter than its length.

A mathematician might have amused himself by figuring out the possible combinations in which that car could have been jammed—I am sure we missed none—and when finally it was disentangled from the forest of stanchions, railings, projecting corners, and other checks to its progress, the crew and I breathed deep sighs of relief.

But as Belawan is isolated in the mangrove swamps, except for the long new bridge of the Deli Railway, one further struggle was necessary before the motor was really "landed" in Sumatra, and we toilsomely manipulated it onto an undersized railway truck. Then I relaxed into a seat and made faces back at the silver-gray monkeys which derided me from the trees, as the train took us up to Medan, fourteen miles inland.

The capital of the Government of the East Coast of Sumatra and headquarters

EVEN THE CARTS IN SUMATRA ARE THATCH-ROOFED

Central Africa has not a greater variety of animal life than Sumatra. Elephants, tigers, myriad apes and monkeys, two-horned rhinoceroses, and the most gorgeous butterflies in the world are to be found in the magnificent jungles of the island. The plant life is amazing in its luxuriance. Some varieties of bamboo shoot up like giant stalks of asparagus, at the rate of a foot or more a day, and in three or four months are waving their fronded tops above centuries-old monarchs of the forest.

PRIMITIVE TRANSPORTATION AND MODERN COMMUNICATION SIDE BY SIDE IN SUMATRA. NOTE THE TELEPHONE WIRES

of the Amsterdam-Deli Company, the most important tobacco company of the Indies, is a modern town, created by the Dutch and laid out in a very attractive manner.

MEDAN A CITY OF MANY MIXED RACES

There is an airy appearance and a cheerful, "white-man's" atmosphere about the official buildings around its spacious square and the cool, shaded streets of its European quarter.

The white bungalows are extremely attractive in their green and well-kept grounds, shaded by tall royal palms, rubber trees, bamboo, banyans, "flames of the forest," travelers' trees, and other tropical growth.

The huge buildings of the Deli Company, with a European hospital and a well-appointed asylum for native immigrants, are almost hidden in the dense verdure of a park filled with beautiful shade trees.

Farther out are the native compounds and various Asiatic quarters, having each its own characteristics.

The Chinese compound, with its elaborate temple, bears the unmistakable mark of the Celestial Republic, with adaptations to East Indian conditions. Its houses, joined together in even-fronted rows, faced with cement or white and tinted plaster, with carved and colored decorations and roofs flaring slightly upward at the corners, are much the same as are found in Malayan towns. Many of the stores and a large part of the trade of Medan are in the hands of Chinese, who, as usual, are extremely prosperous.

Medan's prosperity and importance are due to its location in the center of the rich tobacco lands; and owing to this, with the consequent demand for labor and to the scarcity of native Sumatrese, its population of about 14,000 is a very mixed one.

THE "BIG DAY," SUBSTITUTE FOR SUNDAY

We had arrived in the midst of *hari-bazar* and so were immediately introduced to this interesting feature of Sumatran life.

The tobacco, rubber, and various other estates of the east coast are spread over such a vast amount of territory, with so comparatively small a number of white men in their administration, that the Dutch planters and managers outside of the head office and shipping ports are apt to be more or less isolated from the society of their own kind. Since it is quite without significance to the Asiatic laborers, Sunday is not recognized as a holiday on the estates, but in its place a substitute has been instituted in the fortnightly *hari-bazar,* occurring about the first and fifteenth of each month and literally meaning "big day" or "holiday." Both are pertinent.

On these days all the planters—the general term for white men in any capacity on an estate, either their own or a company's—who are able to do so, flock in from their estates to the towns, those within reach of Medan naturally seeking the capital.

Very few are free to celebrate every *hari-bazar,* and when they do come into town, usually arriving the night before the "big day" with weeks of silence and loneliness to make up for, they waste very little of their time in sleep. Neither does any one else whose room happens to be in the vicinity of their gathering places.

The club and hotels are filled, as they were the night we arrived, with ruddy, healthy-looking Dutchmen in fresh white suits, sitting around big tables in unremitting conversation, while vast quantities of gin and bitters and other beverages are consumed, but with very little effect on these hardy men of the open air.

COMFORT AND PRIVACY IN A MEDAN HOTEL

Among its other advantages, Medan possesses one of the best hotels in the Netherlands Indies. The Hotel de Boer is built upon the plan largely used throughout Farther India—the dining-room, café, office, and kitchen by themselves in one single-story building, open on all sides to the air and shaded by large covered verandas and splendid big trees. Around this, forming three sides of a square separated by a driveway from the central building, the bed-rooms occupy the entire depth of a second single-story structure.

THE SKY-LINE OF THE SUMATRAN VILLAGE OF KEBON DJAHE IS ALMOST AS PICTURESQUE, IF NOT QUITE SO IMPRESSIVE, AS THAT OF GOTHAM

The Sumatrans are a well-to-do, even wealthy, race and build houses of unusual architectural design. Many of them are constructed of teak and bamboo. The carving and paneling reveal a bizarre taste. Note the elaborate pergola-like structure in the center of the courtyard; this is a pigeon-house (see text, page 90).

BLUE-CLAD FIGURES MOVING ABOUT A VILLAGE INCLOSURE IN SUMATRA

That greatest of medieval travelers, Marco Polo, is said to have visited Sumatra toward the end of the thirteenth century, but our first definite knowledge of the island was derived from the Portuguese, who landed on its shores sixteen years after the discovery of America. These rediscoverers were supplanted in turn by the Dutch and the English. The English retired in favor of the Dutch a hundred years ago.

THIS YOUNG SUMATRAN MATRON IS ALL DRESSED UP IN HER SILVER EARRINGS

Much significance attaches to the wearing of earrings in the island. Young girls wear them or not, as they choose. Upon marriage the bride must wear the big silver buttons, much after the fashion of our wedding rings. After the birth of the first child or when five years have elapsed, she must remove them. The sagging, buttonless ears of the old women are among their ugliest features.

EVERY DWELLING IN SUMATRA IS ITS OWN BARNYARD

Contrary to the custom, the floor of this porch is made of whole bamboo poles rather than the split pieces. The floors of most of the houses sag in the middle. The roofs are of thatch, made of the leaves of the atap palm.

Each room has its own covered veranda in front, cool and shady and screened from view, and its own bath in the rear. The comfort and privacy of this style of construction is unequaled for warm climates.

With the aid of the proprietor of the hotel, I procured a servant, a Malay-speaking Kling, to take with us into the interior. Kling is the term used in Malay countries for Tamils and occasionally for other races of Southern India who come to these countries as settlers or for trade. (All other continental Indians are called Bengalis.) Joseph was a Tamil, a Catholic from French Pondicherry, and a very good servant.

THE WHITE MAN'S ADVENT RESISTED WITH FANATICAL COURAGE

The whole of Sumatra has presented a very different problem to Dutch colonization from the organization of Java, with ten times its population. The inhabitants of the larger island, though few in numbers, have resisted foreign interference with the most stubborn and fanatical courage. Each one of its numerous tribes and principalities has had to be subdued in turn, a long and difficult process, as there was none of the almost docile submission of the Javanese.

Sumatra is immense in area and between its different sections there is little inland communication, that which exists being of a treacherous and warlike character. Much of the island remains unexplored; other parts, as the whole of Achin, in the north, are still in a state of protracted warfare, which seems destined to end only with the eventual extermination of the resisting tribes.

The Achinese war alone has cost over 200,000 lives and been an expense to Holland of $200,000,000. The first hostilities date back to 1599, but for the last forty years fighting has been continuous, a guerrilla warfare of surprises and ambushes in the jungles, in which the determined resistance of the Achinese continues undiscouraged, although their government has been deposed and all their towns and strategic positions occupied by Dutch troops.

Leaving the capital, our road at first led through some miles of country dense and green with vegetation, with tiny thatched native huts making picturesque brown spots in the midst of fruit trees and coco palms. As we approached nearer to the hills, this gave way to open plains covered with high grass and low bushes, the characteristic tobacco land of Deli.

THROUGH THE FAMOUS TOBACCO LANDS

The larger estates, especially those of the Deli Company, are divided into sections under the administration of assistant managers. Each year only one-tenth to a fifth of their enormous area is under cultivation, since to maintain the high quality of the tobacco grown the land is left fallow for from five to ten years after each crop. During the first year the natives are permitted to grow rice upon the fallow fields; then the soil is left to itself and to the bushes and rank grass which soon cover it.

The tobacco crop is a rich one, but the demands it makes upon the land and upon labor are such that it is not surprising to find the newer estates annually devoting more and more of their attention and territories to rubber and other less exacting products.

Gradually ascending in altitude, we passed through many miles of these monotonous, fallow-lying plains, their desolate appearance only increased by an occasional row of unused drying-sheds and a few fire-blackened trunks of huge *toealang* trees, solitary survivors of the primeval forest.

The sections actually in cultivation, however, were extremely interesting, with many acres of magnificent tobacco plants growing to a height of five or six feet in closely planted parallel ridges. Frequently they hedged the road on both sides and extended in unbroken rows as far as the eye could follow over the rolling fields.

EACH RACE TO ITS OWN TASK

The work of the plantation is many-sided and the various nationalities employed are usually engaged in their own distinctive branches of labor. Thus, although sometimes replaced by other races, Chinese predominate in the actual work on the tobacco plants; the bullock-cart

AN ELABORATE PIGEON-HOUSE IN THE VILLAGE OF KEBON DJAHE

Sumatra has an area exceeding the combined areas of the New England States, New York, and Pennsylvania. If it were superimposed on this continent, it would extend from St. Louis to Boston.

drivers are Klings; the carpenters are Boyans; the Javanese are woodmen, road-builders, and gardeners; and the Bataks and Sumatra Malays, who are not obtainable in large numbers nor reliable for sustained labor, clear the land preparatory to planting, and build roads and sheds.

The ubiquitous Sikh is often found in his favorite capacity of guard or policeman.

At the time of our trip the tobacco plants were half to three-quarters grown and the drying-sheds were being prepared to receive them. Upon some of the more advanced estates the lower leaves of the plants had already been picked and were hanging in the sheds, threaded on long strings and labeled, while wood fires smouldered at intervals on the ground.

Lines of two-wheeled bullock carts with loose roofs of thatched palm leaves, matting, or even sheet tin, rumbled slowly up and down the roads, hauling supplies and material for the estates. Many of the slow-plodding Indian oxen were magnificent big Guzerat animals, with large humps and long silky dewlaps, and, with their red-turbaned Tamil drivers sitting on the floor of the open-fronted carts, were strongly reminiscent of the tea plantations of Ceylon.

THE HIGHWAYS OF SUMATRA

The road was very good, wide, well made, and much better than I had expected. There is practically no rock in this part of the island, and the metaling for the roads must be imported; nevertheless, the chief highways of the coastal plains and the pass over the mountains are all macadamized.

In the highlands, where metaling has not yet been attempted, such roads as exist are of a very different type. These are of dirt or clay, well built and maintained, and said to be very good in dry weather.

Unfortunately, we were there when seventeen days of continuous rainfall had reduced them to an almost impassable state of soft mud and slippery clay, and, while our experience is perhaps hardly a fair criterion, I can scarcely believe that with the enormous annual rainfall of

Sumatra such is not the condition a large part of the time.

The road from Medan to the interior, however, gave no warning of what was to follow. Leaving the plains and the tobacco plantations, it gradually ascended through wilder country, and presently, with well-engineered zigzags, began to climb into the mountains.

At 3,000 feet altitude we came to the tiny sanatorium of Bandar Baroe, a recuperating station in the clearer atmosphere of the hills for Europeans of the Deli Company enervated by the unhealthy life of the lowlands. It was a wee bungalow of three or four rooms with a wide, pointed roof of thatch, and from its perch on top of the usual piles it looked out between tall tree-ferns over the plain below.

Here we spent the night, having first applied to the *Controleur* for permission. The native in charge had no supplies, so we had recourse to our own for the first of a series of "tinned meals" that continued without interruption until we returned to Medan.

A WAGON TRAIN OF SHIFTING SHADOWS

In the evening, stretched out in comfortable wicker chairs on the bungalow's little veranda, we watched a train of loaded buffalo carts winding stiffly up the hill in a heavy rain. The air was so fresh and cool it was difficult to think of the hot, sultry coast less than forty miles away. The rain pattered gently on the ground and rolled off the overhanging thatch of the eaves in big drops, while the creaking of wheels and soft cries of the drivers drifted up from the laboring freighters on the road.

For more than an hour the train crept slowly past in a single file of vague, indeterminable shapes, with swaying lanterns casting dim circles of light and queer shifting shadows in the misty darkness. We watched in fascination while the tiny spots appeared out of the jungle below and lengthened into a twinkling line which wound up past the bungalow and disappeared one by one above us into the night and the forest.

Early the next morning we continued our climb over the pass. The semi-tropical vegetation which had succeeded the coarse grass of the denuded plains gave way in turn to magnificent virgin forests, unbroken except for the narrow, winding path of the road.

THE SUMATRAN JUNGLE

The enormous straight-trunked trees, ensnared by giant creepers, vines, and huge air plants, made so thick a canopy overhead that only a dim twilight filtered in, and that failed to reach the ground through the dense, impenetrable tangle of vegetation.

Little brooks of clear water rushed steeply down the mountainside, hurrying along to the sluggish yellow rivers of the plains their tiny contributions for the extension of Sumatra's coast. Butterflies flitted in the blue-black shadows; jungle fowl, their brilliance all subdued in the obscure half light, vanished silently from the edges of the road as we approached, and other little creeping and fugitive things sought the security of the unbetraying jungle.

Insects with voices out of all proportion to their probable size screamed shrilly from the branches, and the occasional whistle of a bird or the dull boom of a falling tree echoed through the silent, dark recesses of the wood.

Much of the life of the jungle we saw along this little frequented road which opened up the very heart of the virgin forest, but infinitely more were we ourselves observed. Sometimes the crack of a broken branch betrayed the hurried withdrawal of a larger animal, or a whirr of wings that of some startled bird; but only one's own sixth sense told of the hidden watchers who silently followed our progress with wondering, unfriendly eyes.

PURSUED BY HOSTS OF CURIOUS MONKEYS

The swaying of branches overhead as we zigzagged up the pass did not mean wind in the quiet forest; it meant monkeys, and their antics were an unfailing amusement, whether we kept on or stopped to watch them. Some waited in silence until we drew near, then plunged back into the forest with a crash of branches which inevitably produced on us the shock they seemed to have designed. Some tore furiously along be-

side us through the trees in a desperate attempt to cross in front of the car before we could catch up to them.

When they did cross, far overhead, in a stream of small gray bodies flying through the air between the treetops, they as furiously raced along on the other side and crossed back again. Others clung to swaying branches and bounded up and down in a frenzy of excitement, shrieking gibes in sharp crescendo as we passed.

Often in the midst of their agitation they suddenly lost all interest and forthwith paid no more attention to us; or sat in silence with weazened, whiskered faces peering solemnly down from the trees.

As in Ceylon, it would have been disastrous to leave the motor unguarded anywhere in a Sumatra forest, for everything that prying fingers could unscrew or remove would soon be reposing merrily in the tree-tops.

There were many tribes of the monkey people: little black fellows with very long tails; troops of impudent brown ones; shy black-and-white monkeys with fine silky coats; and hordes of big gray beasts who chased and tweaked each other, evoking shrieks of protest.

Near by, yet aloof from the bands that fed and gamboled together, were a few enormous black bulks which from the distance might have been curious vegetable formations in the trees. But they moved, and I stopped to examine one through the glasses, when my mother suddenly called my attention to something on the other side.

From a leafy branch less than forty feet away a great round head protruded and a solemn black face, comically like a sulky old savage, gazed out upon us. For a few minutes it stared in silence; then with unhurried, deliberate movements returned to a leisurely search for food.

WATCHING THE POWERFUL ORANG-OUTANG

"Orang-outang," I whispered. "Only found here and in Borneo. There are two more on the other side. . . . See him pull that branch down!" He reached up one tremendous, sinewy arm and with the greatest ease drew down a branch that would scarcely have bent beneath the weight of a heavy man. Holding it with one hand, he pawed idly over it with the other, occasionally transferring some morsel to his mouth and promptly spitting it out if it displeased him.

When the branch was duly inspected he released it, and the *swish!* of leaves as it flew back through the air gave some idea of the strength that had bent it.

There was no need of whispering, for although we watched this one for half an hour with the glasses he ignored our presence completely, and except for the first brief inspection not one of the big apes showed a sign of consciousness of our proximity. They were very well aware of it, but were too powerful for fear, and the orang-outang rarely troubles those who do not bother him. We were not inclined to regret this indifference, however, for the "old man of the forest" can be extremely disagreeable when he chooses.

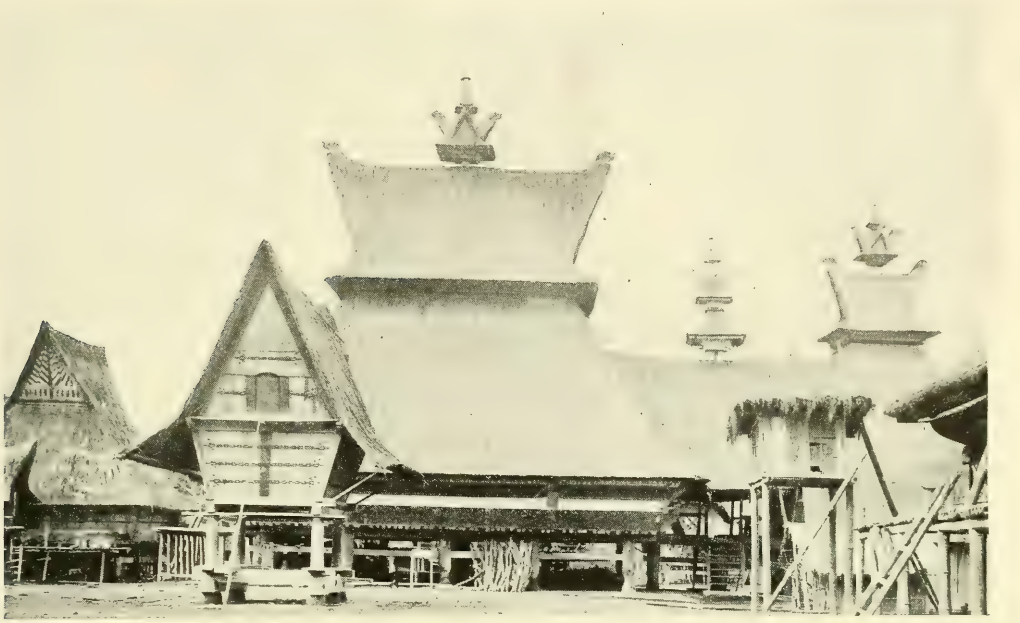
AN UNSOCIABLE JUNGLE BEAST

The other monkeys and apes all moved in troops, but the orang-outangs went alone—severely alone—for their smaller relations seemed to give them a wide berth.

Unlike the monkeys, they appeared conservative of energy, and every movement was carried out with a careful deliberation most amusing to watch. Their huge black bodies were very conspicuous in the trees; their trunks thicker than a man's, with short, heavy legs and arms of extraordinary length and power.

Apparently quite satisfied with the food within reach, the great apes moved lazily along the branches, holding on with their feet and scarcely changing their positions while we watched them. One eventually decided to transfer his operations elsewhere and sauntered off through the trees, swinging his upright body from branch to branch with powerful, far-reaching arms. His movements were still slow and deliberate, but the progress he made was astonishing, though now and then interrupted as he stopped to investigate some delicacy.

The last we saw of him he was hang-



IN FRONT OF EACH SUMATRAN DWELLING THERE STANDS A SMALL SQUARE BUILDING WHICH IS USED FOR A "GOEDANG," OR RICE GRANARY

ing serenely by one long arm, indolently exploring a branch with both feet and his other hand.

The Boekit Barisan, a series of mountain ranges running the whole length of the island near the western coast, splits in the north into parallel-chains which encircle the broad Karo-Batak plateau and the vast area of Toba Lake. In these partially explored ranges there have already been discovered ninety volcanoes, twelve of which are now active, the constructive and destructive forces of Sumatra's formation.

The road from Deli crosses over the northeastern part of the parallel chains into the Batak Highlands, as the plateau is called, by a pass between the mountains Sibajak and Baros.

As we neared the summit of the pass a narrow break in the forest revealed a superb view through the trees, over the blue ravine and densely timbered mountainside, to the wide coastal plain shimmering in the heat-haze below; then the foliage again closed in until we reached the height-of-land and looked out on the other side.

A dull, treeless expanse, scarcely lower than the top of the pass, stretched out before us in limitless brown waves, a desolate tangle of grass broken only by detached volcanic heights. Two active volcanoes, the northernmost of the range, towered threateningly above the others—Sibajak guarding the entrance through which crept the highland road; Sinaboeng rising from the plateau in majestic isolation, its smoke-crowned peak and deep purple sides outlined against the heavy white clouds that hung behind it.

A LAND THAT NEEDS PEOPLE

The first strong impression of loneliness and monotonous solitude that the highlands gave was little changed by the few scattered compounds and occasional patches of cultivation later revealed as we progressed.

In common with the greater part of Sumatra, which could easily support twenty-five times its present population, this section is sparsely inhabited and the villages are small and far apart.

The Batak tribes lead a communistic life, and outside of the hedged confines

THE SUMATRAN MOTHER IS NEVER PREVENTED FROM DOING HER DAILY STINT OF WEAVING BY HER LATEST BORN, WHO IS STRAPPED ACROSS HER BACK

of their compounds—each a little cluster of huts around a large central house—very few buildings are found. The Bataks are mostly peaceful and industrious, occupying themselves with agriculture and farming as well as in hunting and fishing. Their agriculture depends upon the rainfall, which, however, rarely fails; but it consists only of little patches of rice and other grain struggling weakly against the all-encompassing rank growth and is barely sufficient to supply their own modest needs.

Not far from the top of the pass we overhauled the long train of freighters which we had watched in the rain of the evening before creeping up the mountain side past Bandar Baroe. The two-wheeled carts, with low, roughly thatched roofs of branches, extended in a close single file far out across the plain, with the thin legs of their red-turbaned Tamil drivers dangling between the shafts.

The buffaloes were dry and dusty, and by the discouraged droop of their heads seemed to express deep discontent with the wallowless uplands. Among the slate-gray backs of the slow-plodding line, half a dozen light pink albinos—an absurd color on an animal of that size—regarded us suspiciously out of curious white eyes.

THE SIMPLICITY OF THE WOMEN'S ATTIRE

Except for this train, we saw no vehicles in the highlands, but several times passed little groups of pedestrians walking single file along the roadside, on their way to or from one of the markets that are held at intervals in the different Batak villages. Some were even tramping from the other side of the mountain, for since the building of the road the Bataks frequently trade with the nearer compounds of the Deli plain.

Almost all were women, balancing heavily packed baskets of fine matting on their heads, with babies astride their hips, supported by a long scarf tied over one shoulder. The simplicity and similarity of their dress was striking, after the variegated colors favored in Java and Malaya, one dark blue garment—a long *sarong* hung loose from under the arms or around the waist—sufficing in the majority of cases.

Their turban-like head-dresses were of the same dark-blue cloth, peculiarly folded, with drooping corners sometimes

A NATIVE CLOTH FACTORY

Evidently "industrial employment" does not tend to race suicide in Sumatra.

used to support part of the weight of enormous coiled silver earrings.

We rarely saw men on the road; the few that accompanied the women strolled along behind, quite unencumbered with either baggage or babies, and saluted us with a friendly courtesy rather unexpected in a tribe once so notorious for cannibalism. Their garments were quite similar to those of the women, with a shorter *sarong* tied around the waist, and often a coat or short pair of breeches in addition.

Both men and women were barefoot, as usual, and although a stripe or a plaid occasionally varied the dark blue of their clothes, exceptions to the general style were very rare.

The earrings worn by many of the women were of extraordinary dimensions. Only the wealthier could afford them, for each pair was worth about one hundred and fifty gulden and must have represented a considerable part of the family treasure. They consisted of long circular rods of solid silver, about three-eighths of an inch in diameter, passed through the upper part of the ear and bent back into the form of double, reversed coils, the coils projecting far forward on the left side, to the rear on the right. Their weight would have torn them from the ears had they not been partially supported by the corners of the headdresses, and there was apparently no way of removal without first uncoiling one side.

THE BATAKS, KINDRED OF THE HEAD-HUNTING DAYAKS

The Batak people are in many ways the most interesting and remarkable of all the tribes of Sumatra, although as yet comparatively little is known of them. Ethnologically they are related to the head-hunting Dayaks of Borneo.* Their type has not been modified by contact with the outside world, nor even with the more advanced peoples of the coast, and their state of civilization and development is still quite rudimentary, al-

*See "Sarawak, the Land of the White Rajahs," by Harrison W. Smith, in THE GEOGRAPHIC for February, 1919.

AS A SOCIAL CENTER THE HAND LOOM AND THE YARN REEL IN SUMATRA TAKE THE PLACE OF THE VILLAGE FOUNTAIN IN THE NEAR EAST

Many of the sarongs made by the natives are elaborately interwoven with gold threads. They are lacking in originality of pattern, however. The silver filigree-work of the men is much more artistic.

though it is thought that they were once more advanced than they are today.

The reports of early Arabs trading with the Sumatran coast gave the Bataks their evil notoriety as cannibals, eaters of captives, foreigners, and their own aged and decrepit relatives.

The half million Bataks scattered throughout the mountains and uplands of northern and central Sumatra are roughly divided into groups according to differences in dialect. Over a fifth profess Mohammedanism and about half that number Christianity; but in both cases the faith amounts to little more than a form of superstition, showing only vague traces of those beliefs and hardly affecting the village law of racial customs and traditions.

The remainder, including the Kara-Bataks and the tribes of Toba Lake, are animistic pagans, and the circumcision practiced by the former, although doubtless due to some forgotten Mohammedan influences, is not a religious rite.

It is now general in the case of most of these tribes to refer to cannibalism as a practice of the past and at present nonexistent.

CHEATING DEATH BY GIVING ONE'S BODY TO BE EATEN

As to whether or not any tribes continue the practice of eating their aged and decrepit relatives I found a divergence of opinion among the European residents of Sumatra. This form of cannibalism is by no means rare, and usually consists of the ritual killing and consumption of old and infirm males by the younger members of their own tribe.

When the aging warrior feels the waning of his powers, he climbs into a tree encircled by his relations, who dance and chant below. The old man presently drops to the ground, symbolic of the fall

THE COMMUNAL HOUSE AT KAMPONG KINALANG, SUMATRA

Note the means by which the thatched roof is anchored, awakening recollections of the stone-weighted chalets of Switzerland. Many of the houses in Sumatran villages are communal in character, three or four families living in the same dwelling. In places where the natives have come in contact with the Dutch, the interiors of their homes are not without modern conveniences, such as beds, pillows, and canopies. These houses are more comfortable than those of any other people in the Dutch East Indies.

of a ripe fruit, and is knocked on the head and promptly eaten. In this both parties are mutually benefited: the consumers in partaking of the wisdom of their late progenitor; the eaten ancestor by finding immortality as a dimly conscious member of the bodies of his strong, young descendants.

To an animistic form of religion which regards the decay of a body in the ground as the end of all existence, this method of cheating death is welcomed alike by the failing tribesman and his younger relations. Not infrequently the practice is extended to the unfortunate strangers falling into the hands of such tribes, who are devoured that their capturers may receive the benefit of whatever wisdom they happen to embody. To this, rather than to a mere partiality for human flesh, cannibalism as practiced by many tribes may probably be attributed.

Dark clouds presaging the usual rain of afternoon had already appeared on the horizon when we stopped for a hasty tiffin by the roadside. The rains of many afternoons had reduced the road to a bottomless morass of mud and clay, for we had left behind the last traces of metaling a few miles after clearing the mountains.

While the average altitude of the plains is about four thousand feet, the level of the rolling surface varies more than a thousand, and the steep clay hills become appallingly slippery when wet. Up these the car barely crawled, moving crab-fashion, with the rear wheels revolving furiously in spite of "non-skid" tire chains, and flinging unbroken streams of clay-mud in all directions, which my boy Joseph vainly tried to dodge while he threw armfuls of cut grass under our track.

On the down grades we tobogganed with hair-raising speed, wheels locked, and the whole road surface sliding with us, frequently finishing up in the ditch if there happened to be curves on the descent. Fortunately the ditches were

ALL OF THE NATIVE HOUSES OF SUMATRA ARE PERCHED ON STILTS, USUALLY ABOUT SIX FEET HIGH

This practice in home-building suggests to some students of ethnology the thought that the Sumatrans were originally a maritime and water-loving people, who built their houses on posts in the water. They gradually migrated inland, first up rivers and streams, and finally into the interior.

not very deep, but they were quite enough, in their saturated condition, to call out the shovel before the car could be extricated.

Near the mud-hole in which we elected to stop for tiffin, fifty or sixty Batak women were holding a market, all squatting about on the ground, surrounded by piles of dried palm leaves, rattan, and big woven baskets full of grain, dried fish, and various other comestibles.

As seemed generally to be the case throughout the highlands wherever work was in progress, men were conspicuously absent, and the women bargained and gossiped or waited for some one to come and bargain with them, paying little heed to my intrusion in search of photographs. A few were young and not uncomely in feature, but the vast majority appeared old and hideous, the inevitable results of early marriage, overwork, and, above all, the custom of filing the teeth.

THE PRACTICE OF FILING THE TEETH

This practice is quite common among the tribes of Sumatra, and with the Bataks it is invariable among both sexes. The operation, an extremely painful one, is begun at an early age and continued until maturity, when both sets of teeth have been completely filed away down to the jawbone. Although the Bataks' usual food of rice, syrup, and finely chopped meat and fish is soft and easily digested, their inability to chew must be a serious physical disadvantage.

The custom originated as a form of personal adornment, no more strange than many similar practices among other wild tribes of the tropics; but the reasons for it do not seem to have been inherited with the practice itself. To my repeated inquiries the answer was always the same, the usual native explanation for native customs—"Batak people have always done so."

The afternoon rain came up earlier than usual and caught us on a winding ascent to one of the higher levels of the plain. Our doubts of ever reaching the top grew very acute, but after many futile attempts and the burial of a great deal of grass in the deep ruts made by the whirling rear wheels, the car struggled up and we were saved from another night in the open.

The rain was falling in floods when we finally splashed and skidded into the little compound of Sariboe Dolok and sought the meager protection of a tiny rest-house. It had two dark little rooms with a kitchen house in the rear, and as I groped my way inside I sprawled over the body of a large tiger. It was quite dead, but the encounter was somewhat startling.

The house boasted of little in the way of furniture or supplies and the night was very cold, but we were comparatively dry and were offered the luxury of a chicken for supper.

"Luxury" is perhaps a trifle eulogistic for the rubber-like fowl that was set before us. Had we been able to eat him, we might, like the Batak cannibals, have absorbed the wisdom of his hardy experience; but life had been too long and death too recent to admit of any such liberties with the corpse.

Sariboe Dolok, the capital of Simelungen and Karolanden, is not of the importance that its official title might suggest.

It is a lonely settlement of eight or ten native houses, an opium store, the guest-house, and the bungalow of the Assistant Resident, whose life there must be anything but socially gay. This courteous official spoke excellent English, as do the majority of Dutch in the colonies, and, besides affording a great deal of information, made us a present of six eggs—a welcome addition to our tinned supplies, as we had found eggs an unprocurable commodity, even where chickens were to be had.

I also learned from him that the *Kampong* Kebon Djahe, architecturally the most interesting of the Karo-Batak villages and the one I was most anxious to see, lay about twenty-five miles back by the way we had come, on a hill nearly a mile off, and not visible from, the main road.

So the following morning we retraced our way over the fearful clay-mud track, by no means improved by the evening's downpour, until we came to a half-obliterated trail leading westward toward two isolated little white houses. These formed

A COMMUNAL HOUSE IN THE KARO-BATAK COUNTRY

The independence of the native women impresses European travelers as most unusual for an Oriental country. This independence may be the outgrowth of curious marriage customs. For instance, among some tribes a man and woman do not establish a home of their own. The husband remains among his own circle of relations and resides only temporarily with his wife. The children remain in the mother's custody and inherit all of her property, as well as half of that earned by the father and mother together. The remaining half goes to the father's sisters or to the children of those sisters.

the "Government Center," or "European Quarter," of Kebon Djahe, and half a mile beyond, perched on the top of a steep clay bank above a small river, the remarkable buildings of the native *kampong* lay hidden away in a clump of trees.

A REMARKABLE BATAK COMMUNITY

In their chief features, all Batak *kampongs* are more or less alike, but in architectural elaboration Kebon Djahe is unique. Confined, as usual, within a rectangular space of smooth-trodden clay hedged by a bamboo thicket, the buildings were all raised on wooden piles, their immense thatched roofs and extraordinary decorations completely dwarfing the low, windowless sides.

Clumps of plantains, encircled by fences of woven bamboo, sprung like oases from the hard clay ground, and innumerable evil-looking dogs, chickens, and black pigs scratched or rooted in the rubbish beneath the houses. The buildings ranged in size from little granaries and storehouses of quaint and graceful design to the huge communal house, where the men deliberate and banquet and where the fetishistic treasures of the village are kept and friendly strangers entertained (see illustration on this page and on page 76).

Each end of the larger houses terminated in a narrow veranda of bamboo poles, with a bamboo ladder or a notched log leading up to the small opening which it gave into the dark interior.

The immense roofs sloped uniformly on the sides from widely flaring ridges to low, overhanging eaves, but the ends were broken in about half way down, forming great gables beneath the jutting ridgepoles. Brilliantly colored matting woven into artistic designs filled these triangular

AN ELABORATE "SCARECROW" ERECTED TO PROTECT SUMATRAN GRAIN FIELDS

This lookout is made of bamboo, and from the numerous poles long strings are run to all parts of the field. On these strings are tied bits of cloth, which are made to dance as the boy watchman strikes the pole whenever feathered marauders appear.

POUNDING GRAIN: IN SUMATRA THE MILLER IS THE DAUGHTER

The European traveling in this island frequently finds it difficult to get food, especially in the season when vegetables are scarce. During the wet season the natives live almost exclusively on rice. The cereal is cooked very dry and eaten with salt and peppers.

spaces and closed the similar ends of huge dormer-like projections thrown out from the roofs of the more pretentious buildings.

On the communal house and a few others, the vast roofs had a double overhang, with gigantic, top-heavy cupolas towering above them, thatched and shaped in miniature of the dormered roofs below. From their corners, and from the ends of all the ridge-poles and the blind dormers carved wooden buffalo heads with arched, white-painted necks and savagely lowered horns, looked fiercely down to challenge the intruder.

The cupolas were surmounted by curious wooden figures, some on foot, some riding Batak ponies, but all, brilliantly colored, facing out over the treetops, with hands raised in supplication toward the little white house of the Dutch Controleur on the plain.

A PIGEON-HOUSE AND A TOMB

Beside the communal house stood two remarkable structures quite similar in design, both gay with colored carving and decoration. One was a pigeon-house; the other a tomb, from within which the upright body of the last head-man looked out on the village he had once directed.

Under the thatched roof of an open building near by, a group of women with long poles were pounding grain in hollowed-out wooden logs, while other blue-garbed figures, bearing flat trays or

TWO LITTLE PIGS WENT TO MARKET

The live-stock market of a Sumatran village is a lively scene, with its excellent cattle, closely resembling the Alderney type, its porkers, wiry little ponies, goats, and Indian buffalo.

woven baskets on their heads, moved about the inclosure at their various occupations. A few men idled around, but showed little interest in any work more strenuous than chewing *sirih* or following the various strategies I had to employ to obtain the photographs I wanted.

STRENUOUS OBJECTION RAISED TO THE CAMERA

As was often the case in the highlands, the natives, especially the women, were averse to having a one-eyed devil-box aimed at them, and even my disguised efforts in this direction were regarded with deepest suspicion and not infrequently thwarted. With the additional limitations of low-hanging clouds and lack of direct sunlight, and the penetrating moisture so disastrous to films, photographic results in the Batak country were never wholly dependable.

Kebon Djahe was unlike any other village I have ever seen. For several hours we roamed around, exploring the compound, fascinated by all its singular picturesqueness—the remarkable sky-line of the roofs and their fantastic decorations, the blue-clad figures grouped at their divers tasks below, and the effective blending of brilliant colors with the green of bamboo leaves and grayish brown of the moss-covered thatch.

THE AUTOMOBILE DROWNS IN MUD

The sun had gone down unobserved in the clouds and the early twilight had fallen before we left Kebon Djahe. Vague misgivings of the road from there to Sariboe Dolok in the dark had begun to assail my mind, when the car, which had been rocking and skidding over the rain-soaked trail, suddenly plunged deeper into the mud, stopped short, and began to sink.

There was a little hole in the center of the track, no bigger than a man's hand, which on the way up had scarcely been noticeable, but in passing over it in returning, the whole road seemed to open up and engulf us. A furious effort to clear the chasm, whatever it might be, only succeeded in hastening our doom. When we stopped settling the car was so deep that a list to the right brought the

top, which was up, to the level of the road surface, while between the top and the ground on the other side there was barely enough space left to crawl through.

Any further sinking of the car might have permanently imprisoned us, so we hastily crept out on our stomachs through the sticky clay-mud and viewed the catastrophe. It was not encouraging. A careful survey of the car showed it to be hopelessly buried, beyond any possibility of my disinterring it unaided.

The chainfalls, in the equipment box on the rear, were completely out of sight some four feet underground; but even had I dug them out there was nothing to which to attach them, and in any case the car was too thoroughly in the grip of the mud to have yielded to single-handed efforts.

With some difficulty I discovered the cause of the accident. A bamboo culvert far under the road, which had rotted peacefully and undisturbed since it had been laid, had finally collapsed from our weight, after being weakened by our first passage over it.

To extricate the car was a task for a first-class train-wrecking crew, and I felt little confidence of being able to raise half a dozen helpers in that country, especially as I had left Joseph in Sariboe Dolok and would be unable to explain our predicament to any natives I might meet.

Kebon Djahe seemed the one light on the situation; but night was falling rapidly, and as my speedometer cable had broken in the morning and there were no noticeable landmarks, I had only a dim idea how far away the compound might be.

EVERY MOTHER IS HER OWN PERAMBULATOR IN SUMATRA

For my mother to be left alone at night in the wilds of a country until recently addicted to cannibalism, while I set out on an indeterminate search for help was an unpleasant prospect; but as Kebon Djahe might have been eight or ten miles away—a nasty walk in the mud and the dark—that seemed the only solution.

NATIVE PRISONERS MARCH TO THE RESCUE

For over an hour I walked, or rather waded, down the road in the utter stillness of the desolate highlands. Then a few barely audible shouts drifted up from across the plain, and I struggled through the grass in their direction to a tiny paddy field on the top of a low hill.

WOMEN OF CERTAIN SUMATRAN TRIBES ARE NOTED THROUGHOUT THE DUTCH INDIES FOR THEIR BEAUTY

On "Passar," or market days, wonderful arrays of strange fruits and vegetables are displayed for sale, and on special occasions children's toys, ornaments for head-dresses, cooking utensils, and cloth of gay colors may be purchased. Among the tempting edibles are peanut cheese and pineapple sauces. The palm wine of Sumatra is most refreshing on a hot day—and all days are hot in the lowlands.

Through the dusk I could see a little bamboo lookout, such as is erected in every grain field, and, squatting on its platform, two blue-clad figures, who stopped their shouting as I approached. But to my weak efforts in Malay they merely stared in silence and continued to jerk on the strings which, tied with fluttering bits of cloth, intersected the field to frighten away feathered marauders.

From the hill, however, I discovered in the twilight two solitary little white houses about a mile away and struck off to investigate. Soon a tiny light sprang out of the darkness, and when I arrived in its cheery glow I found the Dutch Controleur just returning from inspecting a jail which was in course of construction, and I accosted him with my tale of disaster and appeal for help.

"Certainly," he promptly said, as if foreign motorists mired in the interior of Sumatra came to him every day with requests to be dug out, "I will lend you my prisoners."

Although his jail was not yet built, he had a fine collection—thirty-eight Bataks and Achinese in whom respect for Dutch control had not been sufficiently evident. This was my wrecking crew, and joined by a Dutch planter, who was recuperating in the higher altitude of the Batak lands from an assault made on him by two coolies, we marched as if on a night attack back to the buried motor, with two armed native soldiers as a guard.

A "SHIVERY" EXPERIENCE FOR A WOMAN

I had been absent several hours before the lanterns picked out ahead of us the dark outline of the sunken car blocking the road. As we approached I saw the figure of my mother apparently seated in the clay mire of the roadside, with a dozen motionless forms standing in a shadowy row on the bank behind her. She struggled stiffly to her feet, revealing one of the mud-soaked seat cushions that she had succeeded in dragging from the car, and the silent row melted back into the darkness.

"Who are your friends?" I asked,

after ascertaining that she had suffered nothing more than an unpleasant wait.

"I don't know," she replied, "but I'm very glad to have you back. I've felt rather 'shivery'; first watching them appear out of the dark, one or two at a time; then hearing them talk in low voices. I didn't know whether they were planning to eat me or simply discussing why I chose this particular place to sit in. But for the last half hour they have stood like a row of vultures and haven't made a sound, and that was the worst of all!"

"These are not bad people around here," said Mr. von der Weide, the Dutch planter; "but they are not always to be trusted. I do not think it well to be alone in the highlands at night."

Armed with native spades, shaped somewhat like a wide-bladed adze, and a small forest of strong cut poles which we had fortunately discovered piled by the roadside, the crew attacked the motor.

The prisoners were strong and willing; my training in the recovery of automobiles from strange places had been varied and thorough, and, aided by the untiring efforts of Mr. von der Weide, we soon had a wide excavation made around the car, supporting it meanwhile with shores to prevent further sinking.

Then with the poles as huge levers we pried up each end of the machine a little at a time, filling the chasm underneath with a cob-house of other poles cut into various lengths, until the car, resting on a wooden pier, rose to the road level and was dragged to comparatively firm ground. I scraped off the worst of the clinging mud from those parts that were completely choked with it, and coaxed the motor into starting.

There seemed to be no damage except for twisted mudguards, and we ran back to Kebon Djahe accompanied by Mr. von der Weide, who insisted on our spending the night there—we did not require much urging—while our army was marched ceremoniously back to jail.

The night was extremely cold, at least for within three degrees of the equator, but we had been spared the usual evening storm and although plastered from head to foot with clay mud when we came in, we were very comfortable.

In the morning, after a very early breakfast of Dutch cheese, brown bread, and delicious cocoa, and another hour or more spent in wandering about the fascinating buildings of the native compound, we ran back to Sariboe Dolok. The road, although still in a wretched condition, had dried considerably, as there had been no rain the previous day, and we reached Sariboe Dolok without difficulty, picked up Joseph, and kept on toward Toba Lake.

HOW THE NATIVE MOTHERS WEAVE

Not far beyond the Assistant Residency was the small compound of Kinalang where we made another long stop. It was concealed by the customary thicket of bamboo, and although the houses were smaller, poorer, and not nearly so elaborate in design as those of Kebon Djahe, the native life was even more interesting.

Scattered about the inclosure were crude bamboo frames, attached to the piles of the houses or to poles driven into the ground and fastened at the corners with straw rope. At these the women of the village were seated—their legs stretched out on the ground before them and one end of the frame in their laps—and with the most primitive kind of equipment were producing the *sarongs* for which Kinalang is noted throughout the highlands (see illustration, page 84).

Their movements seemed in nowise hampered by the babies tied on their backs, nor were the babies themselves in the least disconcerted at having their small heads almost snapped off as their mothers worked.

Large bamboo reels held the yarn to be transferred to the spindles, and in little bamboo pails beside each frame were the strong vegetable dyes which the weavers applied on their work, spreading the color with bunches of chicken feathers, while they kept shooting the spindles from side to side between the separated strands of the warp.

In spite of its thriving industry in *sarongs,* the houses of Kinalang showed none of the neatness and decorative features of those of Kebon Djahe. All, except the huge, oddly shaped communal building, were loosely thrown together,

SUMATRA PROBABLY HAS THE MOST REMARKABLE VEGETATION IN THE WORLD

Here are seen the giant "elephant ears" and other characteristic plants and vines which the jungle sends out to recover the land stolen from it. One plant, the *tjindawanmatahara*, has a blossom more than three feet in diameter.

sided with strips of split bamboo or rattan, carelessly thatched, and appearing as if the first strong wind would blow them to pieces.

The interiors were dingy, littered with utensils, and filled with smoke and soot from the open fires that burned in the center of their bamboo floors, while dogs and chickens shared with the owners what little space was left.

SUMATRA'S LARGEST LAKE

About two miles from Kinalang the road descended in a sharp curve, plunged through a narrow cut, and, emerging abruptly on the sheer edge of the plateau, revealed a superb view of Toba Lake, over a thousand feet below.

Toba Meer—the Sea of Toba, as it is called—is the largest inland body of water in the Dutch Indies. It covers an area of nearly eight hundred square miles, entirely hemmed in by the mountains of the Boekit Barisan, at an altitude of about 3,100 feet, and it averages nearly 1,400 feet in depth.

We followed the uncompleted road to its sudden end, about two miles below, and then stopped to eat our tiffin and enjoy the magnificent view. The rugged mountains rising precipitously from the dark water, and the narrow, fjord-like recesses of its winding arms, gave an extraordinary beauty to the great highland lake, which from that point was not unlike the Bocche di Cattaro seen from the Montenegrin Pass.

A cataract tumbled down the mountain side opposite; far below us the fantastic roofs of the village of Harangaul showed picturesquely above a grove of fruit trees in the midst of the green paddy fields of the rich ravine, while out in the lake the long, narrow canoes of the Batak fishermen slipped through the blue shadows, with an occasional glint of wet paddles and dripping nets.

We left reluctantly to return to where the road had branched off, backing up to the plateau again because the unprotected trail was too narrow to enable us to turn the car, then continued down the lake.

The road had dried off rapidly and for more than half the distance was vastly

better than above, as well as traversing a more wooded and much prettier country. There were, to be sure, two narrow rain-soaked cuts where the water had not run off, through which the car barely succeeded in struggling; but the highland roads had made us indifferent to anything short of being permanently mired.

A MEETING OF BATAK AND MALAY HEADMEN

We made further stops at two other diminutive compounds. In Poerba Dolok, as at Kinalang, the women were weaving *sarongs* and pounding rice; at Pematang Rajah there was a market, and a meeting of Batak and Malay headmen — gorgeously dressed, with huge golden buttons in their jackets, finely wrought bracelets around their arms, and *kris* with beautifully carved hilts stuck into the brilliant sashes at their waists.

As we left this picturesque group and drove slowly on, a bamboo chair swung high on the shoulders of four bearers appeared hurriedly up the road, and from it, as we passed, a wife of one of the chiefs gazed curiously down at our unfamiliar equipage.

Shortly behind her, preceded by dire shrieks, three men in equal haste to reach the market came trotting around a corner, each carrying two live black pigs tightly bound in split bamboo and protesting volubly, as they were swung at the ends of the shoulder poles.

We ran over a swampy road, gradually working upward, across a desolate, grass-covered plain. Only a few mountains dim in the distance gave any sense of limit to the rolling plateau, and except for the swift-flying wild pigeons, a few of which I shot to add variety to our larder. there was nowhere any sign of life.

Dark, ominous clouds bore down upon us as we splashed over the soft level stretches, skidded down short, slippery descents, and labored on the upgrades among the holes and crevasses of deep washouts.

In one place the road was evidently being lowered, and for several hundred yards more than half of it had been cut away, leaving a shelf on one side too narrow to drive on, and on the other a six-foot trench which was simply a morass of mud and water. As the shelf was quite impossible, I chose the trench, started up it with a rush, and promptly stuck fast.

No efforts could move the car in either direction. The sticky clay formed solid disks about the flying wheels, completely hiding tire-chains and rope under its smooth yellow coating.

After an hour of unavailing labor, Joseph and I abandoned the effort to extricate the machine, and as darkness was rapidly falling we held a hurried consultation to determine what should be done. It was finally decided to desert the car and attempt to flounder through the mud to the nearest native village. It was a desperate decision, but the only alternative was a night in the car.

Detaching one of the side lamps, whose fitful rays would enable us to avoid the deepest pools of water, the three of us began the sliding, splashing tramp.

About a mile beyond where the car was entombed we came to a cut, and at its edge the dull rays of another lantern showed half a dozen natives putting away some tools in a little shed. Joseph and I immediately scrambled over to question them. Only one spoke Malay; the others were part of his gang of road laborers— an evil-looking lot.

I was surprised at finding human beings there, and, feeling consequent misgivings over the security of our abandoned car and luggage, I asked the man in charge if he or one of his men would, for a suitable consideration, spend the night in an automobile about a mile down the road, to guard it from being molested during my absence. To my astonishment he promptly refused, and, asking the question in turn of his men, met with immediate negatives.

THE NATIVES' DREAD OF TIGERS

I could not account for their unwillingness. The cushions of the tonneau would surely afford as comfortable quarters as any they were accustomed to; it could not be the storm of which men of the

KARO-BATAK WOMEN AT MARKET. NOTE THEIR CURIOUS TOWEL-SHAPED HEAD-DRESSES

The whole island of Sumatra might be termed a vegetable and fruit garden. It is famous for its pepper plantations, its orange, lemon, and pomegranate groves, its coffee and tobacco. The climate of the island is tropical, the equator bisecting it. The average annual rainfall varies from 98 inches in the "dry country" to 139 inches in the wet region.

highlands were afraid; and the reward I had offered, though small enough, was probably equivalent to about a week's income.

Then it occurred to me that they were afraid of the automobile itself, and I hastened to assure them that it was not only dry and comfortable, but quite safe; that I had locked it up, and that it could not move until I myself released it.

"Oh, it is not that," said the spokesman, with an air of having slept in automobiles most of his life.

"Well, what is it then?" I was both curious and a trifle annoyed.

"Tigers."

"Tigers?"

"Yes, indeed," said Joseph nervously, translating. "He say plenty of tigers here come down sure and eat him up!"

"But not in the automobile," I objected.

"Oh, no; tiger first take him out."

I readily persuaded the men to help carry our luggage to the village, five miles as he estimated it, but nothing would induce any of those natives to spend the night within reach of the great prowling beasts.

A walk down the mountain to the rest-house on the lake was quite as arduous as we had feared. The trail descended some 1,500 feet in long zigzags. When we finally reached our destination, my mother was nearly exhausted, and we were both too grateful for the shelter to be critical of what we found. But even so, one could hardly have called the accommodations luxurious. The whole building leaked; it was overrun with toads, lizards, spiders, cockroaches, and various other pests.

We rose stiff and unrested in the morning, but when the early mists had lifted from the green island facing us, the beauty of the clear highland lake banished every thought of weariness and discomfort.

Few lakes in all the world can offer such a setting as the Toba Meer. The encircling mountains of the Barisan chain rise sheer from the water's edge, their guttered sides white-flecked with the foam of many rain-fed cataracts.

In the purple shadows along this somber rim, indistinct little villages cling precariously to the steep slopes, checkered with the tiny squares of a few light green or yellow paddy fields.

Overhead the winds of the monsoon may moan and whistle about the peaks, but the deep blue surface of the lake is seldom ruffled, save by the V-shaped wakes of the dug-out canoes, which skim about like tiny water-bugs in the vast dimensions of the silent mountain amphitheater.

Amid such surroundings we lost all count of time until hunger necessitated our return to the motor car, which was salvaged from the mud only with great difficulty.

Many trials and adventures were encountered in making our way down from the heights, but when we reached Pematang Siantar we were out of the highlands and back again on the coastal plain, although still at a considerable elevation and a long distance inland. The mountains from this point sloped quite gradually toward the sea. It was again warm at night, warm and soggy, and we returned to sleeping *on* the bedclothes, after the unaccustomed treat in the highlands of sleeping under them.

A MALAY COSMOPOLIS

Siantar forms a trade link between the highlands and the coastal regions, and at its market half the nationalities of the Sundas may be found, beside many from the rest of Malaysia, from India proper, and from the extreme East. There in the morning I wandered for over an hour between rows of women and boys who squatted on their heels behind their trays and baskets, while the stream of different tribes flowed steadily past.

Mostly they were Bataks, hideous with red-stained, toothless mouths; Sumatra Malays in brilliantly flowered *sarongs;* and blue-trousered Chinese wearing the typical broad brown topees, or straw affairs woven in the form of baskets and filled with a kind of lacquer.

Others bargained, gossiped, or wandered aimlessly among them — Malays from far corners of the archipelago; pretty Sundanese girls with white jackets and smoothly combed hair; Tamil women in scarlet *sari,* and Tamil men with white *dhoti* and red turbans; Bandjarese, Sikhs, and even wandering Pathan trad-

SALESGIRLS IN THEIR SUMATRAN OPEN-AIR GROCERY STORE

The young woman standing in the central background is wearing the curious coiled silver earrings peculiar to the island. The preparation for the reception of these earrings begins in babyhood, when the lobe of the ear is pierced and a bit of tightly coiled banana leaf is inserted. The puncture is gradually expanded by the pressure of the unrolling leaf.

ers from the Afghan frontier, long-haired and dirty, with heavy, boat-shaped shoes and *lungi* trailing from their rakishly set caps.

THE CHINESE COOLIE'S GROWING POWER

There were many more, but of every five two were Chinese. Some were nearly naked, half-starved new arrivals peddling trays of small nicknacks hung from poles across their calloused, sweating shoulders. Others, laborers earning high wages on the plantations, squatted about a native restaurant in one corner of the market, talking at high speed with their mouths full of rice or sundry delicacies that no one else would eat.

And there were many, sleek, well dressed, and bejeweled, who had passed in a brief time through both these first stages and now showed the result of indifference to privation and an infinite capacity for overwork, the only assets brought with them from the Middle Kingdom.

The irrepressible Chinese immigrant coolie seems destined to become the financial power of Sumatra, as he already is in Malaya, Java, and elsewhere in the East Indies.

From Siantar we ran back to Medan. The road was hard and dry, a trifle rough at first, but such a transition from the soft ditches we had been following through the highlands that the very steadiness of our progress began to alarm us.

After the conditions of Batak highways, an uninterrupted run of thirty-five miles makes one gravely expectant of dire things to follow; but the road grew better instead of worse, and we drove into Medan early in the afternoon with a ninety-mile run behind us—our longest in Sumatra.

Before we reached Medan we passed a heavy, two-wheeled transport cart on its way to some estate, drawn by the most enormous buffalo I had even seen. A thin, sweating Chinese coolie walked beside it, wearing a battered pair of blue trousers and a round, peaked hat of bamboo, undoubtedly the aggregate of his worldly possessions. Just as we drew alongside, the buffalo got wind of a near-by wallow, stretched his neck, and snapped the extremely simple harness—a piece of rope holding the wooden collar to the shafts.

While the huge beast ambled off to enjoy his mud bath the coolie repaired the harness by unraveling a few lengths of thread from some burlap sacking in the cart, plaiting it into a cord, and then splicing the broken rope. This done, he extracted from the waistband of his trousers what appeared to be a handful of dried peas—probably counted down to the last grain that would support life—ate his meal, and set out to recover his cumbersome charge. But the buffalo was otherwise minded.

For thirty-five minutes the patient Chinaman vainly tried to make the huge animal leave the mud-hole, himself getting plastered with slime and deeply scratched on some dead branches.

At last the relentless yanking on his nose-rope spoiled the buffalo's repose, and he followed his driver to the cart with a fine effect of being very bored. When the collar was again fitted over his neck the oversized animal swung his head fretfully and the harness promptly snapped once more. Without a change in expression the coolie started to make a new repair, and the last we saw of him was a patient figure squatting on the road, laboriously sawing off with his teeth the end of the buffalo's nose-rope.

From Siantar to Tebing Tinggi the road had passed through dense forest, the edges of the right of way choked with wild plantains, "elephant ears," and all the quick-growing plants and vines that the jungle sends out to recover the land stolen from it.

Only a few ambitious tobacco estates broke in on the ranks of the vine-entangled, straight-trunked trees; but from Tebing Tinggi the run to Medan took us through some of the most thriving estates in Sumatra. In that fertile section was represented nearly every variety of plantation found on the island.

THE RUBBER PLANTATIONS OF SUMATRA

Second in extent and in importance to the vast tobacco fields—surpassing them in many cases—were the acres devoted to rubber, both indigenous *Ficus elastica*, many branched and buttress-rooted like a

A CHINESE COOLIE MENDING THE HARNESS OF HIS BUFFALO CART

In the meantime the buffalo is taking his daily noonday bath and siesta in a near-by mud-hole.

banyan, and *Hervea braziliensis,* enormously popular in Malaya.

Liberian coffee thrived in the shade of the *hervea* or under the protection of vast coco-palm groves; ten-foot pepper vines climbed thickly up the trunks of small trees, clumps of tall areca palms waved their graceful fronds high in the air, and dense forests of teakwood, planted in even rows, overhung and shaded the road.

Other things without end grew in like profusion, and all helped prove what the planter enthusiasts had told of the island's future. With rich alluvial soil, unfailing rainfall, and tremendous natural resources, only the lack of labor and the deterrent influence of warring tribes has held Sumatra practically at a standstill while its sister island, Java, has flourished so greatly.

Sumatra's exploitation has been carried on very slowly and cautiously, it is true, but without the aid of the severe though wonderfully beneficial methods of the Java culture system; and before the close of many years its economic development and wealth will astonish even those familiar with the statistics of Java.

We reached Medan early in the afternoon, and the next morning ran down ten miles to the end of the road and took the Deli railway for two or three miles to the port of Belawan, in the mangrove swamps.

A wearying two-hour struggle ensued in the moist, oppressive heat of the low coast—a contest against heavy odds in the shape of booms that were too short, planks that were too weak, spaces too narrow, and stanchions that interfered, and all the other things that make a nightmare of loading and unloading motor cars on ships unprepared to handle them.

But we won in the end, with the help of a placid Dutch officer, who showed no anxiety over the disruption I was causing the company's sailing schedule; and when the car was at last on board, the *Rumphius* dropped down the river to the Straits, swung southeast for Singapore, and shortly sunk the low east coast of Sumatra in the haze of late afternoon.

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THE REMOVAL OF THE NORTH SEA MINE BARRAGE

By Lieutenant-Commander Noel Davis, U. S. Navy

Photographs from the U. S. Navy Department

For an account of the extraordinary feat of the U. S. Navy in planting 56,611 mines in the North Sea, the reader is referred to "The North Sea Mine Barrage," printed in The Geographic, *February, 1919. The removal of the mines was perhaps an even more remarkable achievement, and was under the direct command of Rear-Admiral Joseph Strauss, who also had command of the expedition that laid the mines.*—The Editor.

WHEN time and study have enabled an accurate history of the World War to be written, it is not at all unlikely we shall read that the North Sea Mine Barrage was primarily responsible for the collapse of Germany.

The inconceivably great task of closing the exits of the North Sea had been accomplished; an impregnable wall of mines stretching from Scotland to Norway, a distance of 240 miles, had become a reality, and that deadly weapon, the submarine, which had daily brought us nearer to inevitable defeat, regardless of the gallant efforts on the battlefields of France, at last was bottled up within the North Sea, no longer free to carry on its depredations.

The construction of the barrage was a magnificent achievement, typically American, demanding the concentrated efforts of many of our largest manufacturing establishments to produce the countless complicated parts which make a mine; the building of huge assembly plants in Scotland; a special fleet of mine-layers; and then, in the face of the enemy, the laying of these thousands upon thousands of delicately adjusted spheres, one at a time, each in its predetermined position in the North Sea.

The hitherto intrepid submarines were conquered, because they would not risk a passage across the barrage. Several tried and were destroyed; others, critically damaged, managed to reach port and told of this new danger which confronted them. And here it was that the barrage became most fruitful.

As long as the submarines had an even chance in battle, they were willing to continue. Now the realization was forced upon them that they faced an intangible foe, an ever-present foe, always waiting and ready to explode upon the slightest contact. Realization grew into fear, the fear to mutiny; new crews could not be mustered, and so the U-boat menace was ended.

WHEN GERMANY'S ONLY CHANCE OF VICTORY FADED

With the collapse of the submarine campaign, Germany's only chance of vic-

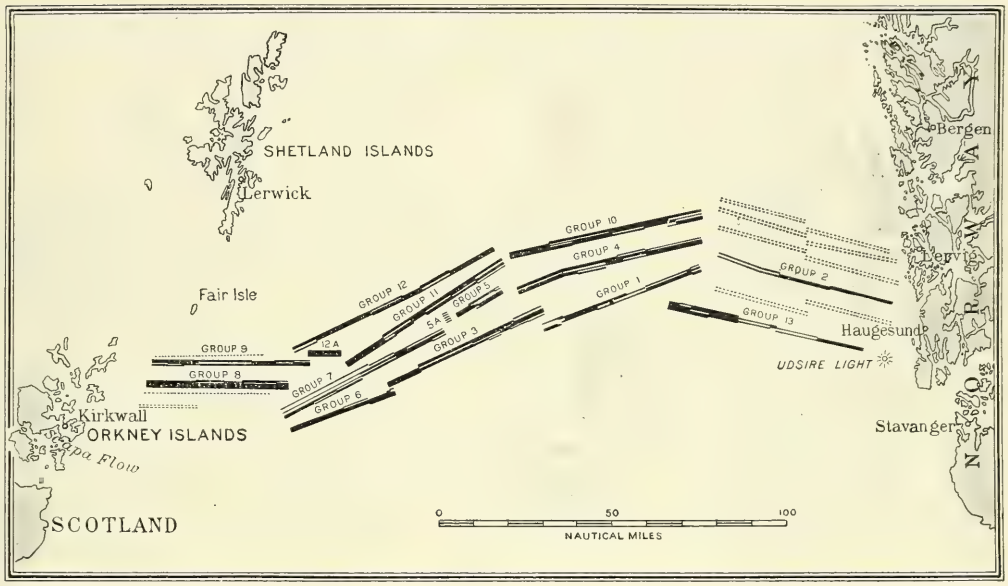
GENERAL MAP SHOWING THE LOCATION OF THE MINE FIELDS

The narrow Straits of Dover had been closed previously by mines and nets. With the completion of the North Sea Barrage, stretching from Norway to the Orkney Islands, the fate of the German submarine was sealed.

tory faded. She knew it better than we, and at once circuitously sent forth her first proposals for peace, which developed with such remarkable rapidity that a few weeks later the Armistice was signed and the war was over.

Then came the period of reconstruction, with tasks almost as great as those of the war itself. The havoc and devastation had been frightful. Cities and farms without number must be rebuilt, millions of starving people had to be fed, and, perhaps most immediately serious of all, the thousands upon thousands of mines which had been laid must now be cleared away, in order that the countless vessels loaded with food and troops might navigate in safety the long-obstructed ocean highways.

Concentrated in the North Sea Barrage



DETAIL MAP OF THE MINE GROUPS

The mines laid by the United States Navy are represented by full lines, and are further distinguished by group numbers. The broken lines indicate the mines laid by Great Britain.

were more than 70,000 mines—more than had been laid during the entire war in all the other waterways combined—and of these slightly better than 80 per cent had been laid by the United States Navy during the six months preceding the Armistice. Now, with the arrival of peace, we had accepted the responsibility of removing every mine that we had laid.

Think what it meant. Here was a death trap containing more than 21,000,000 pounds of TNT and extending over an area of approximately 6,000 square miles! This mighty belt of destruction had plucked from Germany her only hope of victory, because the crews of her submarines, after losing their comrades, who tried in vain to cross it, mutinied and refused to risk their lives in what appeared a certain death (see maps, pages 104 and 105).

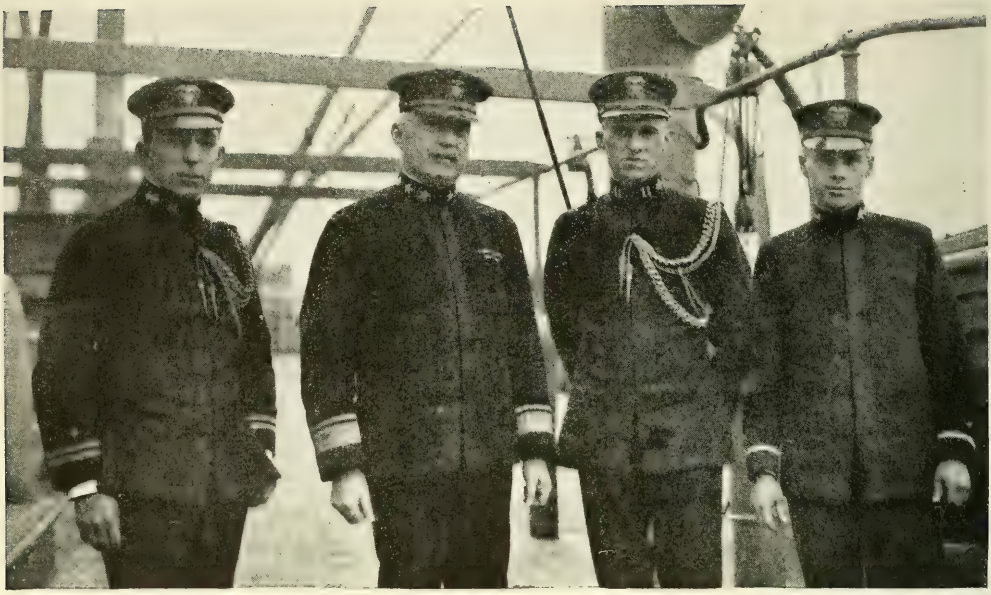
Although the Germans had learned the secret of our mines within a month after the first one was laid, they were unable to devise any means of safeguarding their ships to prevent them from exploding these delicate weapons—weapons which now confronted us with all the potential destruction that had been designed to subdue an enemy.

We had veritably sown our wild oats, and now we had to reap them; for the only means of removing the mines was to cross and recross the mine fields, time after time, until we were sure that not a single mine was left.

HOW MINES ARE SWEPT

Sweeping mines, for by such name is the process of removing them called, is not a particularly intricate art. It consists essentially in dragging a heavy wire between two vessels. In order to bury the wire to a sufficient depth beneath the surface to insure catching the mines, "kites" are attached to the sweep-wire just astern of each vessel. These kites fly down in the water in much the same manner that an ordinary kite flies up in the air (see page 108).

When a mine is caught in the sweep-wire, it is dragged along until the slender wire which holds it to its anchor breaks, allowing the mine to rise to the surface, where it is destroyed. This is ordinarily done by puncturing it with rifle-shots, so that it sinks and becomes innocuous. No



REAR-ADMIRAL JOSEPH STRAUSS AND HIS STAFF ON BOARD HIS FLAGSHIP, THE "BLACK HAWK"

Left to right: Lieut.-Commander Noel Davis, Rear-Admiral Joseph Strauss, Lieut. W. K. Harrill, and Ensign K. C. Richmond.

MARKER BUOYS TO INDICATE THE POSITIONS OF THE LINES OF MINES WERE PLACED AT INTERVALS OF THREE MILES THROUGHOUT THE LENGTH OF EACH GROUP

Besides a differently arranged flag, each buoy was painted to show which line of mines it marked and its position in the group, in much the same manner that the signs on the street corners indicate the streets. The buoys were assembled on board, using the sphero-cylindrical cans which are seen on the stern of the ship.

attempt is made to recover the mines, for the risk involved is far greater than the mine is worth (see pictures, pages 110 and 116).

During the war the German submarines laid hundreds of mines in the entrances to European harbors, and toward the end had scattered some along our own Atlantic coast. Permanent sweeping forces were required to keep the channels cleared, and, while vessels so engaged were occasionally lost, our chief concern was from a totally different source.

These mines which Germany had laid, likewise the British mines, were what is known as the "horn type." Leaden horns project from the mine and must be struck and broken before the mine explodes.

Our mine was different. Invented shortly after the United States had entered the war, it had made the construction of the North Sea Barrage possible. A piece of metal the size of a nail was sufficient to explode it. Furthermore, a long antenna stretching up above the mine enormously increased its radius of action. Vessels built of anything but wood could not survive in such a field. Even the sweep-wire was sufficient to detonate the mine, and, worse, one mine frequently caused other mines to countermine, and if one of these should be beneath a sweeper——!

THE MAN CHOSEN FOR THE INTRICATE TASK

The task before us indeed was delicate. It called for concentrated genius and iron-handed resolution to tackle such a problem, and Rear-Admiral Joseph Strauss, United States Navy, was selected for the job. Possessing an intricate knowledge of explosives and their caprices, a knowledge derived from long periods of duty in the Bureau of Ordnance, and having personally directed the actual construction of the barrage, he was, without qualification, the one man in the Navy best suited for such an exacting undertaking. But even he didn't have the faintest idea what the ultimate method of sweeping would be.

Every possible scheme must be tried with the hope of finding a solution—a solution not only for clearing the mines in the shortest possible time, so that shipping might resume its normal routes, but, primarily, one which would afford the maximum safety to the men who were to be engaged in this hazardous work, for human life had at last returned to par.

The first thing to be done was to ascertain the then existing condition of the barrage.

It was now December. The mines had been laid from three to six months. In order to limit the depredations of the U-boats as quickly as possible, it had been necessary to lay these newly developed mines without subjecting them to the exhaustive tests so essential to the logical development of all intricate and delicate mechanisms. Perhaps the firing batteries had become exhausted or some other unforeseen defect had rendered them inactive. This we must know at once; for, aside from the shortness of the winter days in such high latitudes (60 degrees north), gale follows gale with such rapidity that small craft are scarcely ever safe, and sweeping during the winter would be impossible.

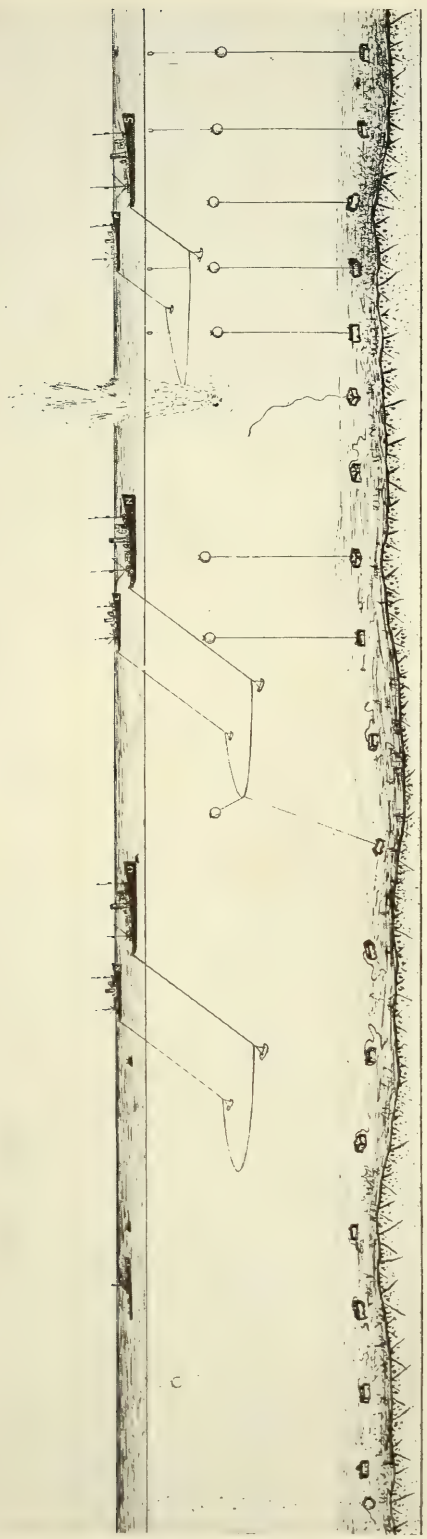
If we were to complete our task during the coming summer, everything must be in readiness to begin active operations at the first break of spring.

MAKING SAILING-SMACKS MINE-PROOF

Steel vessels could not, of course, be used for this first experiment, and self-propelled wooden vessels invariably have so many iron fittings about their hulls that they, too, would be in constant danger. Admiral Strauss therefore borrowed from the British two of the only type of vessels left—wooden sail-boats sixty-nine feet long.

Sweep mines with these? The idea was discouraged from the beginning. How could two small fishing-smacks, with their sterns tied together by a heavy sweep-wire, keep position on each other, pass sweep, and maneuver back and forth across the mine field? Ridiculous as the idea seemed, it was our only chance to gain the information that was needed.

The first step was to make them mine-proof, as far as such a thing were possible. They were hauled out upon the ways at Inverness, the hulls inspected, nail-heads driven in and plugged, and other metal fittings sheathed with wood.



Drawing by Noel Davis

DRAWING SHOWING THE LOCATION OF MINES UNDER THE SURFACE OF THE WATER AND HOW SWEEPING IS ACCOMPLISHED

There were, on the average, five parallel lines of mines in each of the thirteen groups laid by the U. S. Mine Force. Each of the five lines was swept, as shown above. The leading pair of sweepers regulated their sweep so as to touch only the antennæ of the mines, and in this way explode as many as possible. The next pair of sweepers set their sweep to a greater depth, so as to saw the mooring of the remaining mines, and the last pair followed in their wake to catch any mines which might have been missed and to replace either of the leading pairs in case their sweep was broken. The sub-chaser, astern of all the sweepers, sank the mines cut adrift as they rose to the surface (see page 110).

They then were given a heavy coating of tar.

Manned with volunteer crews, these little vessels, the *Red Rose* and the *Red Fern,* got under way from Inverness with the two tugs, *Patapsco* and *Patuxent,* at sundown, December 22, 1918.

The *Patuxent* and *Patapsco* were to escort them as far as the mine fields, stand by while the experiments were being made, and then give them assistance, if required, when they again were off the field.

THE FIRST MINE EXPLODES

The next morning found the *Red Rose* and *Red Fern* on the southern edge of the barrage. There was a threat in the air as the little vessels stood up to each other, passed the sweep, and headed across the lines of mines; low-flying black clouds scudded rapidly across the gray sky, while the barometer went down with alarming rapidity.

Then, grr-ung!

A towering column of white water impelled by the explosion of 300 pounds of TNT sprang high above the masts of the *Red Rose.* Separated by only a short length of manila rope, which insulated the sweep-wire from the ship, the explosion virtually lifted the little vessel from the water, shaking her until it seemed as if the timbers in her hull would fly apart. When she settled down again the sea gushed in between the planks until the pump could scarcely keep the vessel dry.

This was the first mine. Five others followed, most of them, fortunately, further astern. It was indeed a pretty sight to see these

tiny vessels tacking and wearing in perfect unison, keeping station on each other by furling topsails or streaming sea anchors.

But the experiments were cut short by the gale foretold by the morning's sky, which broke with the fury of a hurricane in the early part of the afternoon. The sweep was cut adrift, sails reefed, and course set to pick up the *Patapsco* and *Patuxent,* who by now had been left out of sight beyond the horizon.

EXPERIENCING ONE OF THE GALES THAT MAKE THE NORTH SEA NOTORIOUS

By 3 o'clock the sun had set and the oncoming darkness added to the difficulties. Shortly before midnight the tugs were overtaken, but they were suffering equally in the gale, and a few minutes later were again out of sight.

How it blew! The *Red Rose* was hove to under storm-jib and staysail forward and triple-reefed mizzen aft. First, the jib went, followed by the topmast, then but a bare pole. A few hours later the mizzen-boom snapped, and for the next 36 hours the *Red Rose* wallowed in the North Sea waves—vicious waves, that seemed to come at once from all directions.

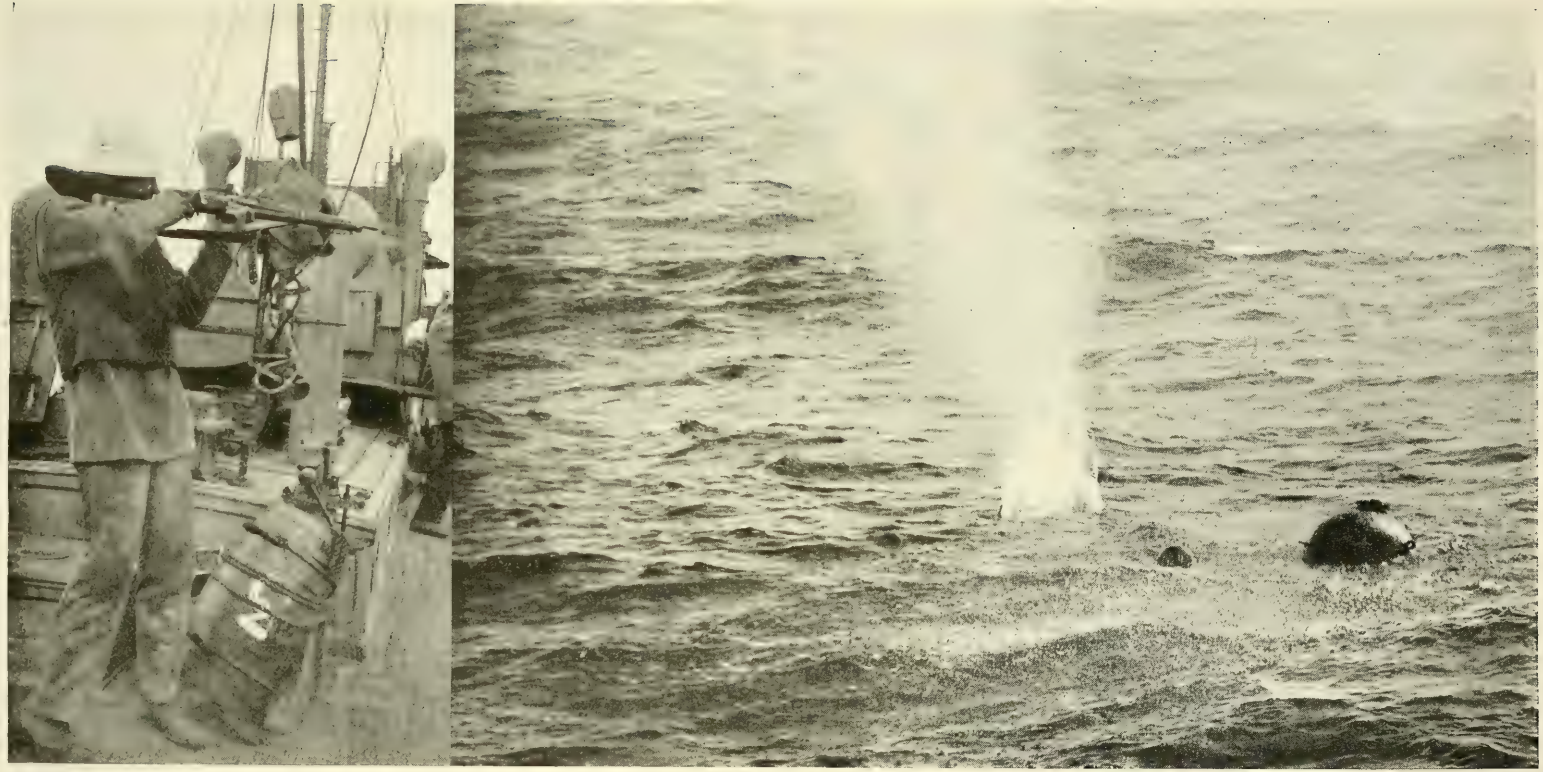
The *Patuxent's* rudder was carried away, and she had to return to port.

Not knowing whether the *Red Rose* and *Red Fern* were safe, a number of British men-of-war were sent out to join the search, but most of the would-be rescue ships had to return to port, for they could not weather the gale.

Then followed days of anxiety at Inverness. Had it been asking too much of such fragile craft to undertake this expedition at this period of the year? The North Sea is notorious the world over for its violent weather. But, when hope had almost ebbed away, word came from Peter-

BETWEEN THE STERNS OF THE TWO SWEEPERS IS STRETCHED THE SWEEP WIRE, ADJUSTED BY MEANS OF THE KITES TO RIDE AT A DEPTH OF APPROXIMATELY 260 FEET (SEE DRAWING, PAGE 108)

These two vessels are a half mile apart. A mine has just exploded in the cod (the center) of the sweep.



WITH THE LITTLE SUB-CHASERS ROLLING HEAVILY IN EVEN THE SLIGHTEST SEA, THE ORDINARY RIFLE WAS FOUND MORE SUCCESSFUL THAN THE MACHINE-GUN FOR SINKING THE FLOATING MINES WHICH WERE CUT UP BY THE SWEEPERS

When the mine is struck a metallic ring is heard, much the same as in a target gallery. If the bullet misses, a small spout of water is thrown up where it strikes. The small float which supports the antenna of the mine can be seen to the left of the mine itself. The bullets open holes in the mine, which soon fills with water and sinks to the bottom.

head that the *Red Rose* had reached port on Christmas morning. The next day the *Red Fern* anchored in St. Andrews Bay, blown 200 miles from her destination.

So ended the first experiment on the mine fields. Six mines out of 56,000 had been destroyed—a negligible number, of course; but we had found what we had set out to find—the mines were still there, waiting for us now, as they had waited for the enemy's submarines previously.

To clear the whole barrage by means of sail-boats was, of course, impossible. From the outset Admiral Strauss realized that rugged, powerful vessels, able to keep the sea in practically all weather, would be required to do this work. Furthermore, the United States Navy at last possessed an ample fleet of vessels of this type, for almost every week one of the new mine-sweepers was being completed and placed in commission.

But here, again, we were confronted with that ever-baffling problem: How could we protect these vessels so that they could cross the mine fields and strike the mines without exploding them?

Sheathe them with wood? It would take a year to fit out the necessary ships, if it could be done at all. Paint them heavily with tar or other non-conductor? Not sufficient protection.

THE MIRACULOUS HAPPENS

It began to look as if the task were impossible of accomplishment. Then the miraculous happened. I can remember it as if it were yesterday. A timid knock at the Admiral's door and Ensign D. A. Nichols (now lieutenant) hesitated and came in.

"I have a scheme, sir," he addressed the Admiral, "for protecting ships against the mines; but it is so simple that I'm almost ashamed to suggest it."

It was simple, too, but one of those simple things which require the mind of a genius to discover. Fifteen minutes later the necessary gear to test the scheme was being assembled, and that same afternoon the tests were carried out—and were successful!

Our greatest handicap was now removed and we were free to use steel ships for sweeping the barrage as soon as they could be fitted with the Electrical Protective Device!

More exhaustive tests were carried out—rigid to a detail—to find if there were any points which had been overlooked; but every test proved even more conclusively the effectiveness of the device. Specifications for its construction were cabled to Washington and the actual manufacture began a few days later.

OUTFITTING THE MINE-SWEEPERS

Our most pressing task now was to get the new mine-sweepers, which were still scattered among the various ports on the Atlantic coast, equipped with this device, fitted with sweep-gear, provisioned for a long period away from home, and then get them started for the North Sea to begin actual work at the break of spring.

Admiral Strauss returned to the United States to supervise this work, leaving Captain R. C. Bulmer, U. S. N., in command of the mine-sweeping detachment at Inverness, to make the necessary arrangements preliminary to the arrival of the mine-sweepers.

A base for operations had to be selected; fuel and water facilities provided; suitable sweep-gear must be developed, and, if possible, further experiments carried out to gain some definite knowledge of the behavior of the mines.

It was March before the *Patuxent's* rudder had been replaced, and while this was being done both she and the *Patapsco* were equipped with home-made electrical protective devices, so they might cruise in safety through the fields of mines.

Newly developed kites, capable of attaining the great depth at which we were required to sweep, were borrowed from the British Admiralty, together with a few lengths of serrated sweep-wire, so called because of its peculiar lay, which enables it to saw the mooring of a mine, and the *Patapsco* and *Patuxent* set out for the barrage to experiment with this equipment, which was later to be used by the vessels fitting out at home.

The sweep was passed and sounding tubes were slid down to the kites to measure the depths at which they were

ONCE A MIGHTY UNIT OF GERMANY'S PROUD HIGH SEAS FLEET

Kirkwall, the base of the American mine-sweepers, is separated from Scapa Flow by only a narrow neck of land. When it was known that the interned German fleet was being scuttled by the men on board, Admiral Strauss ordered all his fleet then in harbor to proceed at full speed to Scapa, hoping that they might succeed in beaching some of the vessels before they had filled and sunk. But the work of destruction was so complete that our vessels were of no assistance.

flying; then the course was altered to head across the mine field.

The first few explosions were well astern and in the center of the sweep, and although the terrific concussion shook the ships from end to end, the men quickly became used to the novel sensation and apparently enjoyed it. Mines, too, kept popping up behind the sweep, having been cut from their moorings before the sweep-wire could reach the mines and cause them to explode.

A MINE EXPLODES BENEATH THE "PATUXENT"

Then suddenly it seemed as if all bedlam had broken loose. Towering columns of water were belched up on every side! The *Patuxent* seemed to stop for a moment as if stunned, and then, as the spray and water settled back again, great clouds of black smoke, mingled with flame, poured from her funnel.

The lights below decks dimmed and went out; the floor plates in the fire-rooms had been hurled from the decks; an ever-widening circle of brown, discolored water spread out around the ship. The vessel had been countermined.

Luckily, the mine which had exploded below her had been planted at the deepest level, and, aside from minor damages, which could be repaired in a few hours, she had not been injured. A mine fired by the sweep-wire had caused these others to explode sympathetically.

We had sampled a danger with which we were to be faced constantly in the coming months—a danger that no human effort could avert.

Many of the supersensitive mines had exploded prematurely shortly after the barrage was laid, and we had hoped that only those possessing normal stability now were left; but such was not the case. The Electrical Protective Device

THE LITTLE TOWN OF KIRKWALL, SCOTLAND, WITH ITS BARREN, WIND-SWEPT HILLS, HAS PLAYED AN IMPORTANT RÔLE IN AMERICAN NAVAL LIFE DURING THE PAST FIVE YEARS

Hundreds of patrol craft engaged in hunting submarines and in escort work were based here until the Armistice. Four months later the Mine-Sweeping Force made this its base while clearing the North Sea Barrage.

would prevent mines from exploding when in contact with the ship, but against these countermines it was of no avail—and an upper-level countermine beneath sweeper would undoubtedly destroy her.

KIRKWALL, AMERICA'S MINE-SWEEPING BASE IN THE ORKNEYS

The next mine encountered in the sweep exploded, shattering the sweep-wire, and before the break was mended a blinding snow-storm cut short further experiments. The two ships then proceeded to Lerwick, a drowsy little town in the Shetland Islands, and later to Kirkwall, in the Orkneys, choosing the latter place as our base for the coming operations.

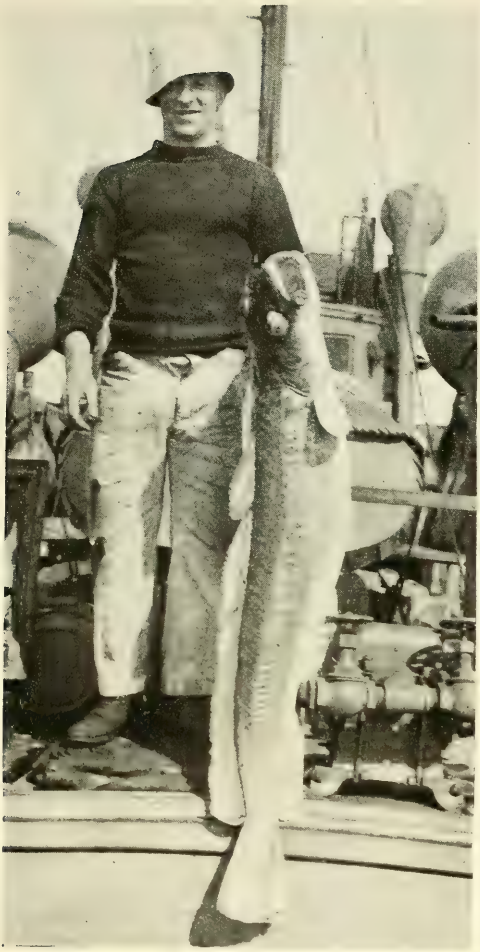
During this experimental trip twenty-five mines were exploded and fourteen were cut adrift. As many of these floating mines as possible were sunk by rifle fire, but it was difficult to find them after they had once been lost to sight. It was evident that special ships would be required to follow up each pair of sweepers and sink the mines as fast as they appeared. The only vessels then available were the little sub-chasers, which had been doing patrol duty in the English Channel, and twenty of them were obtained and sent to Inverness.

By the middle of April all arrangements were completed and we were ready to begin actual sweeping the moment that the mine-sweepers arrived. Oil-ships, colliers, gasoline, and water boats had been borrowed from the British Admiralty; the sub-chasers had been drilled in their new duties; special buoys had been obtained for marking the barrage, and the sweepers were by then halfway across the Atlantic.

THE SWEEPERS ARRIVE FOR THE BIG TASK

On April 20, 1918, the first twelve of these sturdy little vessels arrived in Inverness. What a weird future confronted them!

A veil of mystery surrounded everything, even more than in the silent operations of the war. Those who manned



THOUSANDS AND THOUSANDS OF FISH WERE KILLED BY THE EXPLOSIONS OF THE MINES

The sub-chasers kept the larger ships constantly supplied with cod, pollack, and herring, which are most abundant in the North Sea. Occasionally a curious specimen, such as shown above, was picked up by a vessel.

the sweepers only knew that they had been selected to sweep the hitherto invincible barrage. The ships had suddenly been ordered to the navy yards at Boston and Norfolk, where curious appliances of every description had been placed on board. Workmen invaded the ships and began stringing wires and installing elaborate electrical panels. Some one said these were to keep the mines from exploding when their vessels struck them. Then, too, rumors had reached home that the *Patuxent* had narrowly escaped destruction while experimenting in the barrage.

The day following the arrival of the sweepers Rear-Admiral Strauss returned to Inverness and hoisted his flag on the *Black Hawk,* the flag and repair ship of the force.

Not a moment was to be lost. If humanly possible, the barrage must be cleared away during the year, and that meant by October, for from then on the short days and severe storms would make our efforts futile.

As soon as the necessary overhaul incident to a transatlantic voyage had been completed, the mine force got under way; the sweepers and six chasers headed for the barrage; the *Black Hawk* and other chasers for their new base at Kirkwall.

THE RESULTS OF THE FIRST TRIP

No attempt was to be made on this first operation to clear a definite area of mines. The object was experimental. Several appliances remained to be tested, chiefly an amplification of the Electrical Protective Device whereby the mines would all be exploded by an electrical connection to the sweep-wire; also, we must know more definitely the present condition of the field—what percentage of the mines remained, and were they still in the positions in which originally planted, or had the storms and currents scattered them about.

At the end of two days the ships returned to port, having accounted for 221 mines—less than half of 1 per cent of the total number we had laid. The electrical scheme for exploding the mines was not successful, and, even worse, it had a most alarming effect on the magnetic compasses. The powerful solenoids caused by the current in the insulated sweep-wire wound around the drums had made the compasses point as much as ninety degrees from the magnetic meridian; and the navigators found their ships actually going east or west when they were thought to be headed north.

The mines, as far as could be told, were still in place and had not dragged from their original positions.

None of the ships had been damaged, although numerous instances of countermining had occurred.

From the results of these first two days it was obvious that at the present rate of sweeping it would be impossible to complete the work within the year; so Admiral Strauss cabled a request to Washington that sixteen additional sweepers be fitted out and dispatched as expeditiously as possible. He also made arrangements to charter from the British Admiralty twenty newly built steam trawlers and man them with our own crews, these vessels being required as marker boats to enable the sweepers to maintain their positions while maneuvering upon the field.

A BARRIER 260 FEET DEEP IMPENETRABLE FOR SUBMARINES

By the 10th of May the sweepers were ready to go out again. This time a definite area was to be cleared.

The barrage was composed of thirteen separate groups of American mines. Each group consisted of from two to six parallel rows of mines, and the mines in each row were laid at one of three levels—upper, middle, or lower—the three forming a complete barrier in a vertical plane to a depth of 260 feet.

The average group contained five rows, and of these three were laid at the upper level to give the surface barrage the greatest density. The reason was psychological: Submarines, knowing the barrage was there, would prefer to risk crossing on the surface, even if they knew their chances were less.

The upper-level mines were now our gravest concern, for the damage done a sweeper by the explosion of one of these would, of course, be far more serious than from a lower-level mine.

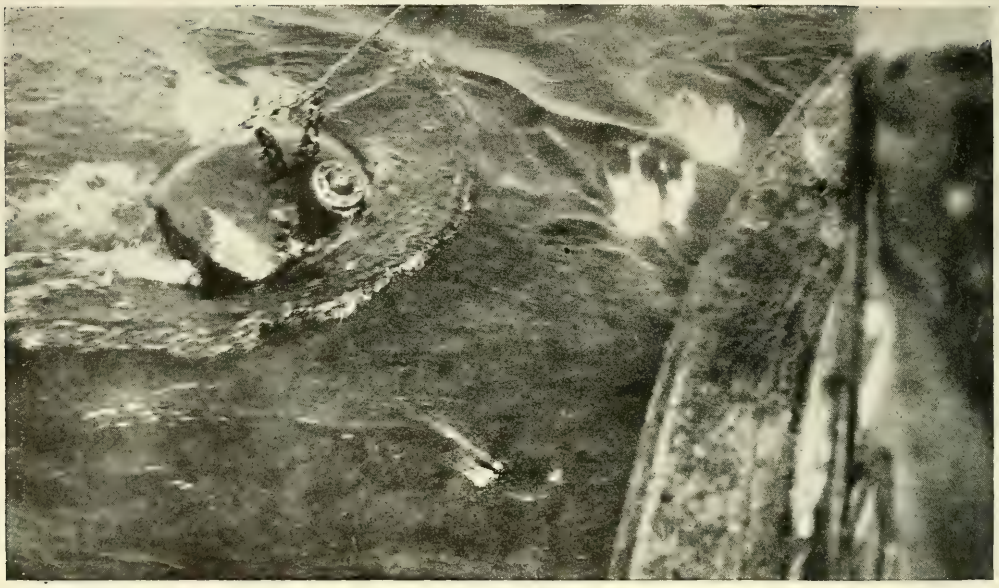
Group 12 (see chart, page 105) was selected to be cleared on this coming operation, since it consisted of only three rows of mines, only one of which was laid at the upper level.

With the danger from countermining reduced to the minimum, the experience gained in sweeping this group might provide a further means of safeguarding the ships before the more dangerous groups were undertaken.

A GIANT HALIBUT, WEIGHING MORE THAN 400 POUNDS, CAUGHT NEAR THE ORKNEY ISLANDS

In order to reduce the possible effects of countermining still further, each pair of sweepers was to work independently of the others, so that all pairs should be evenly spaced along the length of the field. Then, if an exploding mine should cause others in its vicinity to countermine, the possibility of damaging other sweepers than the one pair was very remote.

The method of sweeping to be used was what is called transverse sweeping—that is, the sweepers were to cross the lines of mines perpendicular to their direction, then turn, recross, and so on. This method is much more laborious than attempting to keep a line of mines be-



A MINE FOUL OF THE "PATUXENT'S" KITE

In less than a minute after the picture was taken the mine exploded, blowing several men overboard and slightly injuring the commanding officer. Most of the force of the explosion was expended in the air, however, and the damage to the ship was not extensive (see text on this page).

tween the pair of sweepers and steaming longitudinally down its length (longitudinal sweeping), but was deemed to be safer, since the possibility of being above a mine when it exploded was considered less.

THE CASUALTIES BEGIN

No sooner had the sweepers reached the field than the casualties began, and, curiously, the cause was from an entirely unexpected source. From now on this same thing happened so frequently that it seemed almost incredible that it had not occurred before.

The *Patuxent* was the first victim. Her sweep had been severed by the explosion of a mine and had to be hauled on board to be repaired. By the time the kite was within sight (it can be seen only a few feet below the surface), a mine could be seen floating near it. Evidently its mooring had fouled the kite and it was necessary, of course, to clear it before the kite could be lifted.

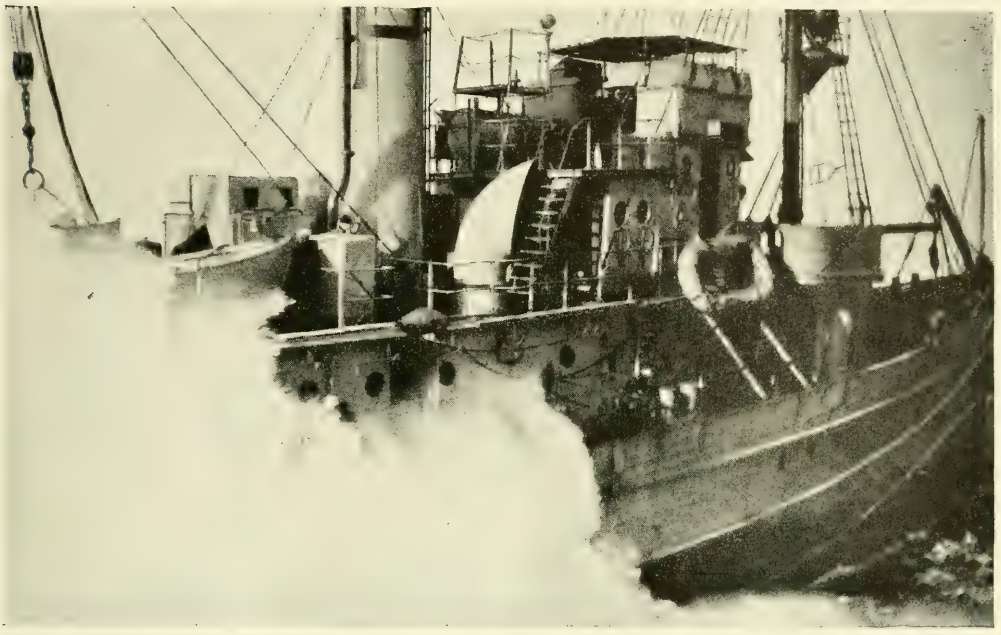
The commanding officer, realizing the danger, sent all hands forward and went aft himself to do the work, assisted by one man.

The mine was within four or five feet of the ship's side when, suddenly, without warning or apparent cause, it exploded.

For an instant the entire ship was obscured in the mass of flying spray, and when it had subsided four of the crew could be seen struggling in the water. Fortunately, all of them were rescued by their comrades. The captain was, perhaps, the luckiest of all; standing only a few feet from the mine when it had detonated, the only injury he sustained was the loss of his right thumb, which had been amputated by a flying fragment.

Since the mine was not submerged, the force of the explosion was largely spent in the air, and consequently the damage to the ship was not serious. A few days in dry-dock were sufficient to repair her.

Up to the time of this accident, when mines were found foul of the kites or the sweep they had been regarded more or less as curios. Many had been hauled on board; for, according to design, they were supposed to be quite safe when on the surface. Now no one trusted them. One



A CURIOUS EXPLOSION

While a sweeper was going alongside her mate to pass the sweep, a mine, from some unknown cause, exploded between them. The entire after part of this vessel was drenched, but the damage, fortunately, was not serious.

ship which at the time had a mine on board even went so far as to double the risk by throwing it back into the sea.

Infinite care, however, could not entirely eliminate this particular danger. In the first place, the mine could never be seen until it was dangerously close to the ship; then the course of action that was chosen might or might not prove the proper one.

A TRAGIC MISHAP

Two days after the *Patuxent* was damaged an identical casualty befell the *Bobolink,* but with far more serious consequences. The captain, as in the *Patuxent's* case, went aft to clear the mine himself, sending all hands forward to a place of safety except those actually required to assist him.

The towing engine had been stopped as soon as the mine was sighted, leaving it somewhat submerged. It exploded before anything could be done to clear it.

The commanding officer, Lieutenant Frank Bruce, U. S. N., was killed. The first lieutenant and several men were blown into the water, the first lieutenant falling 100 feet from the ship. The men who plunged in after them succeeded in saving all, even though the first lieutenant had been rendered unconscious by the fall.

The *Bobolink* was critically damaged by the explosion. The entire after body had been distorted, parts of the plating being driven in two to three feet by the concussion. The rudder was gone, the engine disabled, and the ship was leaking badly. Her boilers, which are well forward, were not injured and enabled the powerful wrecking pumps to take care of the water.

Two other sweepers towed the damaged vessel to Scapa Flow, near Kirkwall, where she was docked and temporary repairs made. Later she was towed to Devonport, where she still remained in dock when the Mine Force sailed for home, five months later.

Seventeen days after the operation began, Group 12 was completed and the vessels returned to port. Several other accidents had happened, two of which

DUE TO AN ELECTRICAL PROTECTIVE DEVICE, THE "LAPWING" SUCCEEDED IN PASSING SAFELY OVER THIS MINE, WHICH EXPLODED AS SOON AS IT WAS OUTSIDE THE RADIUS OF IMMUNITY ESTABLISHED BY THAT REMARKABLE CONTRIVANCE

Aside from shaking the vessel severely and breaking such articles as chinaware and lamp globes, no damage was ordinarily incurred by an explosion so far astern.

necessitated docking the sweepers to stop the leaks caused by explosions.

The rate of sweeping had been far below our expectations, but we were learning.

VAST QUANTITIES OF SWEEPING GEAR BLOWN AWAY

The most serious factor, aside from the loss of life, was the expenditure of sweeping gear. Thousands upon thousands of fathoms of serrated sweep-wire, together with more than fifty plunger kites, had been blown away by the exploding mines. Our original estimates had not anticipated so large a loss for the entire barrage as had been expended by this single operation. Moreover, both of these articles were exceedingly difficult to obtain.

Our present rate of work was far too slow to complete the barrage within the year, and even the thought of the idle winter days in that miserable climate, while we waited again for spring weather to resume operations, was most disheartening.

WORKING EIGHTEEN HOURS A DAY

Every minute on the mine fields was being utilized. In that high latitude, where the summer days are so unusually

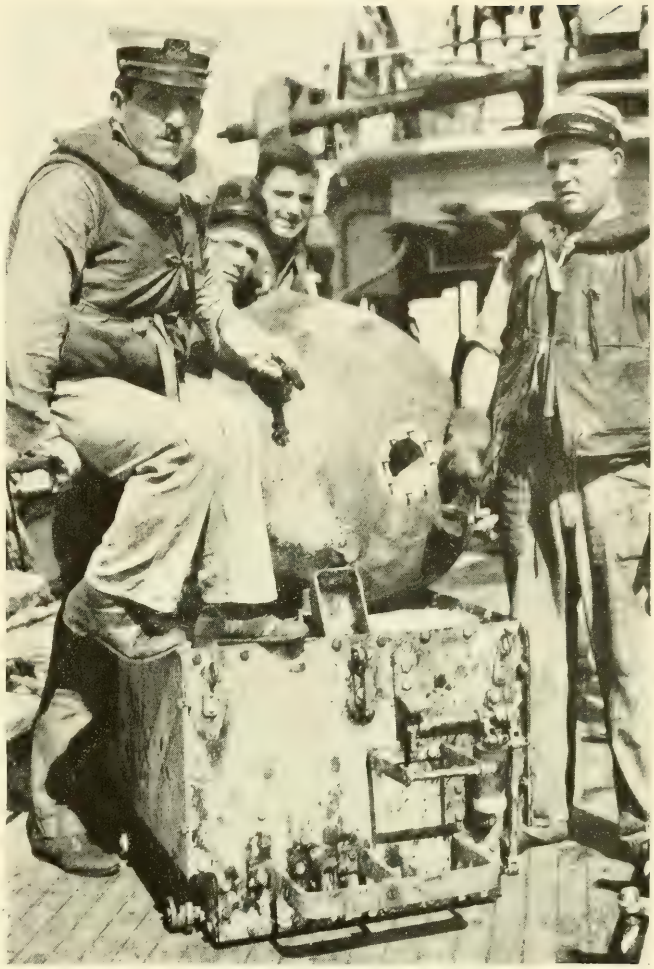
long, the sweepers worked from four in the morning until ten, and sometimes even later, at night.

The days in port were equally busy. Fuel, water, provisions, and new sweep gear had to be obtained; boilers had to be cleaned and many repairs were always required. The machine-shops on the two repair-ships buzzed incessantly, and as soon as everything could be finished the ships were under way once more for the barrage.

Group 9, the largest group of mines that has ever been laid, was selected for the next operation.

Five thousand five hundred and twenty mines had been laid within its boundaries. The same method of sweeping was to be used as on the previous operation, except that the three pairs of sweepers were to work together, sweeping their section of the field longitudinally instead of transversely. It was a bold experiment, but if they could demonstrate that the danger was no greater than in the other form of sweeping (this largely depended on their ability to keep between the invisible lines of mines), then there might yet be a possibility of finishing the task before winter.

Admiral Strauss spent several days on one of these sweepers in order personally to judge the relative merits of the two methods.



A MINE WITH ITS ANCHOR, WHICH FOULED THE SWEEP AND WAS HAULED ON BOARD

This extremely dangerous practice was automatically discontinued after the *Bobolink's* disaster (see page 117).

A SUBMARINE WRECK CAUGHT IN THE SWEEP-WIRE

An interesting indication of the success of the barrage was encountered while sweeping in the central portion of this group. The *Heron* and *Sanderling,* while crossing the lines of mines, were suddenly brought almost to a standstill; then their sweep-wire snapped. A few minutes later a huge patch of oil rose to the surface and spread out astern of them. The sweep had fouled the wreck of a submarine which had been sunk in the barrage. Curiously, the mining squadron, when passing close to this same spot a few days after they had laid the field, sighted the dead body of a German sailor floating in the water.

From the records of the Admiralty the wreck was presumed to be the U. B. 127.

The sweeping progressed slowly. The weather, although it was now June, was almost as violent as it had been during

TO INCREASE THE SPEED OF SWEEPING, EACH LINE OF MINES WAS MARKED BY BUOYS PRELIMINARY TO THE SWEEPING OPERATION

The picture shows a pair of sweepers crossing a line of upper level mines, three of which have been exploded by the sweep wire. The buoy-laying ship (from which the picture was taken) is following the pair of sweepers across the field to plant a buoy when 500 yards from the line of mines as indicated by the explosions.

the winter months. Not until 27 days after the operation had begun was the group finally completed. Some improvement had been made. No ships had been seriously damaged, although many minor accidents had happened.

There was some consolation that our rate of sweeping was slightly better than that of the two British detachments engaged in clearing their portions of the barrage; but it was far from satisfactory; the rate had to be *tripled* if we were to finish in 1919!

THE CHIEF CAUSES FOR SLOW PROGRESS

The principal losses of time were due to the frequency that sweeps parted, with the consequent delay in repairing them, and to the difficulty in navigating with sufficient accuracy to insure that every square foot of the field had been covered. This latter difficulty necessitated sweeping the same area over and over again to make sure no mines were left.

The first cause offered little room for improvement; with practice, the sweeper crews became more dexterous in mending sweeps and repassing them, but the explosions which parted the wires could not be avoided.

The second cause of loss of time presented many possibilities for improvement: First, by placing all the vessels in formation, so that all the ground could be definitely covered; then have them steam longitudinally down the field. The experiment made by the three pairs of sweepers on the previous operation showed that this was practical; they had suffered no greater losses than the other sweepers, and, although their rate of sweeping was no faster than the others, it was plainly due to the difficulty of telling where they were.

The second possibility for improvement lay in defining accurately each row of mines with suitable buoys before the sweepers were sent out. Some doubt existed if such a thing were possible, for it had appeared in previous sweeping that the mines exploded or rose to the surface in such apparent disorder that to place marker buoys in exact positions relative to the individual rows of mines was almost out of the question. But we at least could try.

The Admiral directed that a Buoy-laying Squadron should be fitted out at once, in order to have the new fields marked by the time the overhaul and refit of the sweepers was completed.

THE BUOY-LAYING SQUADRON BEGINS WORK

Since the Buoy-laying Squadron automatically took over the duties which the trawlers had, in a lesser way, been performing, it was decided to fit out ten of these vessels for sweeping (they had been built expressly for that purpose by the Admiralty), using them astern of the regular sweepers to catch any mines which might have escaped the initial sweep. This would give a large, compact formation, with sufficient breadth to cover the entire width of the group.

In order to reduce as much as possible the loss of time due to parted sweeps, three pairs of sweepers were to steam in column along each row of mines; then, when the sweep of the leading pair was broken, they should drop out of formation, repass, and take position as the last pair. In this manner it was hoped that the sweepers as a unit might sweep continuously the full length of the field, keeping at least one pair in action on each line of mines, so as not to lose track of its position.

Five days after the ships re-

WHILE HAULING IN HER SWEEP, THE "BOBOLINK" SIGHTED A MINE ENTANGLED WITH THE KITE

Before it could be cleared, the mine exploded, killing the captain and blowing several men from the ship into the water. The smoke of the *Bobolink* can be seen emerging from the explosion (see page 117).

A COUNTERMINE (SEE PAGE 112)

When least expected, the sea, with a mighty roar, would oftentimes belch up a pillar of white, shattered water. The cause of countermining could never be determined. Occurring always when least expected, this was a constant source of danger to the vessels in the field.

turned to port they were under way again for the mine field. Not much rest after 27 days at sea, where Sundays and holidays were omitted from the calendars.

The buoying of the little Group 12A had been successfully completed, and seven hours and forty minutes after the sweepers began not a single mine remained.

It seemed incredible, impossible, that this could be true! Ordinarily it would have taken us five times that long.

Here indeed was real cause for jubilation. The enthusiasm of the force was unbounded, and for the first time it became possible to foresee the end of our task.

AN IMPRESSIVE SIGHT

By this time the buoying of the large Group 11 was far enough advanced for the sweeping to begin immediately.

On they came, 24 sweepers, 10 trawlers, and an equal number of the little sub-chasers.

EXPLOSION OF A DEEP-LEVEL MINE

Due to the tremendous pressure of the water on top of the mines which were planted at the lowest level, the force of the explosion was not sufficient to throw the water high into the air, as is done by the upper-level mines. The shock of the explosion was felt immediately. The "slick" did not appear until approximately thirty seconds later.

It was an impressive sight to see that armada, formed for sweeping, standing up the mine field, the air reverberating with the continuous roar of the exploding mines, and simultaneously the glistening pillars of white water springing up behind the sweepers, poising for an instant, and then disappearing.

Still farther astern the fainter plop-plop of the rifles and machine-guns could be heard, as the chasers filled the floating mines with holes.

A SHORT-LIVED TRIUMPH

The triumph of the day was contagious. No casualties had occurred to mar the inauguration of this new method of sweeping, and it began to look as if the solution of our difficulties had been accomplished.

But the morrow held in store a flood of catastrophes of every kind—the worst day we should have to face during the entire operations.

The first victim was the *Curlew*, which was crippled by the explosion of a mine fouled in her kite and was forced to return to Kirkwall for repairs. A few minutes later three mines were countermined beneath the *Patapsco;* but fortunately the damage was not serious.

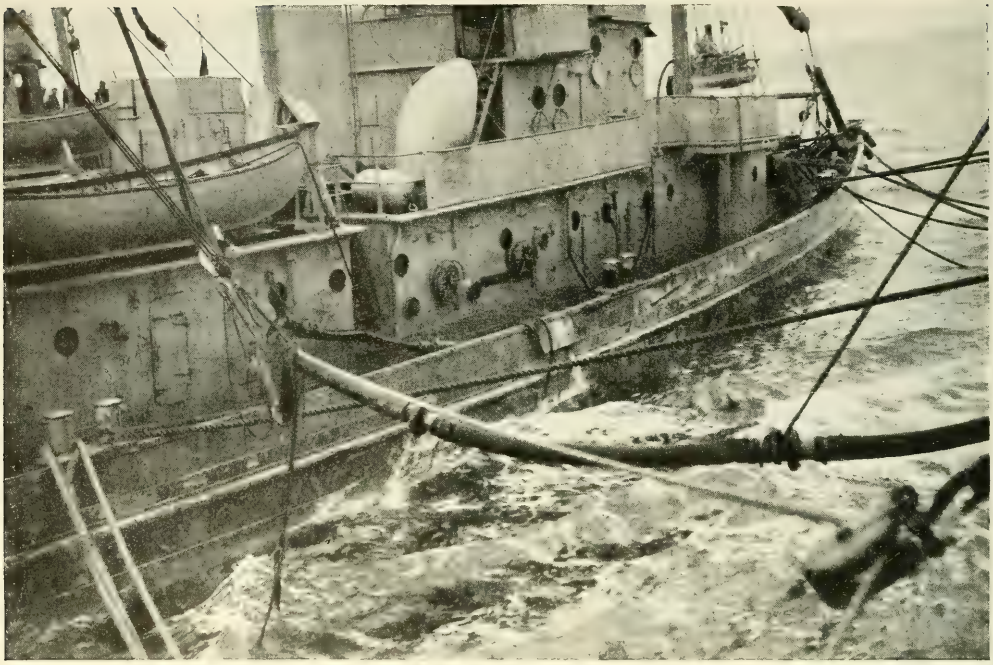
The *Penguin* followed, with numerous minor damages from a mine foul of her kite, and the same thing befell the *William Darnold* almost at the same time. Both ships were able to make temporary repairs on the field and continued operations.

The *Lapwing* was next. She was seriously countermined and had to return to port.

Sub-chaser 46 exploded a mine while sinking it, and was injured so badly she could not remain at sea.

A BATTLE WITH THE ELEMENTS

As if such havoc were not sufficient for a single day, six upper-level mines were countermined beneath or close aboard the *Pelican.* When the mass of water had subsided and the vessel could again be seen, she was sinking. Then began one of the most remarkable strug-



SAVING THE "PELICAN"

Seventeen minutes after the hull of the *Pelican* had been shattered by a series of successive countermines, the *Auk* on one side and the *Eider* on the other had made fast and, with their wrecking hoses spanning the intervals between them, were pumping to their maximum capacity to keep the vessel, whose high bow was then but two feet above the water, afloat until they could reach port.

gles of will power against the elements ever recorded.

Seventeen minutes after the explosions, Captain Bulmer, who had gone out to direct personally the sweeping operation, had placed his flagship, the *Auk,* alongside the *Pelican,* and her powerful wrecking pumps were throbbing to their full capacity to keep the riddled ship afloat. A few moments later the *Eider* had made fast on the other side, and her pumps were doing likewise. The *Teal* then passed her towline to the *Pelican,* and the four vessels, lashed together, headed slowly for port.

At that time the weather was good, and the *Auk* and *Eider* were able to keep the *Pelican* fairly well afloat; but when they were still 50 miles from land a head sea began to rise and the situation grew rapidly worse.

As the vessels were tossed about by the sea, the pump-lines parted, and before they could be repaired the water had gained until the *Pelican's* bow was practically submerged, while her stern projected high above the water. To add to the difficulties, nightfall had overtaken them.

The *Pelican* sank lower and lower; her forward fire-room bulkhead, which alone kept her afloat, was buckled and distorted by the pressure of the water on the forward side. As the water crept higher and higher, the bulkhead was expected to burst at any moment. The crews on the *Auk* and *Eider* worked desperately to get the pumps started again.

Since the vessel was in danger of sinking at any moment, it was unwise to keep unnecessary men aboard; so Captain Bulmer asked for twelve volunteers to remain to do the necessary work.

Every man stepped forward!

The twelve strongest were chosen and the rest had to be ordered off their ship against their will. It was a sight that dimmed the eyes, to see these twelve men,

THE EXPLOSION OF AN UPPER-LEVEL MINE ASTERN OF THE "PATAPSCO"

The darker central portion of the upheaval which rises after the first white spouts of water break the surface is discolored by the gases of the TNT.

when nothing further could be done, grouped together on the stern, high out of water, singing old-fashioned melodies throughout the night.

Then at last, after nineteen hours of struggling, this cortege of ships succeeded in reaching the sheltered waters of Tresness Bay with the *Pelican* still afloat. The dogged determination and skillful seamanship of Captain Bulmer alone had saved her.

Such holes as could be stopped were plugged, and the following day the ships proceeded to Scapa Flow, where the *Pelican* was docked and sufficiently patched to permit her being towed to Newcastle-on-Tyne, where extensive repairs were undertaken.

The morning following the *Pelican* accident a curious mishap befell the *Flamingo*. After the day's sweeping was completed the vessels used to anchor near the mine fields in order that all hands might get as much rest as was possible in the few short hours of darkness. The deep water and the soft bottom of the open sea do not, however, make an ideal harbor, and on this occasion the *Flamingo* found herself at daybreak several miles south of the spot where she had anchored the night before. While weighing her anchor, which was secured to the end of her sweep-wire, her stern was virtually lifted from the water by the shock of an exploding mine. She had dragged during the night until she was in another group of mines. The damage done by the explosion necessitated docking before she could resume her operations.

AN OFFICER AND SIX MEN SINK WITH THE "BULKELEY"

On the 12th of July, two days after the *Flamingo* was damaged, our most serious accident occurred. Again it was due to a mine fouling a kite. Before the trawler *Richard Bulkeley* could take any steps to remedy the situation, the mine exploded and her hull collapsed under the terrific concussion.

Within seven minutes the vessel had gone down. The other vessels in the

THE FEW DAYS IN PORT BETWEEN THE SWEEPING OPERATIONS WERE EQUALLY AS BUSY AS THE DAYS AT SEA

Besides fueling, watering, and filling up again with stores, the sweeping gear had to be overhauled and repaired, the boilers cleaned, and as many of the leaks stopped as was possible without docking the ship.

vicinity had cut their sweeps, rushed to her assistance, and succeeded in rescuing all except one officer and six men.

AN INSPIRING ACT OF HEROISM

A moment or two before the *Bulkeley* had disappeared from sight, one of those inspiring deeds occurred which live forever in our memories and glorify the noblest traditions of the service. A man, dazed by the shock of the explosion, struggled to the deck. Seeing that he had no life-belt, Commander Frank R. King, U. S. N., took off his own, and, quickly buckling it about the man, helped him to get clear of the ship before she took her final plunge. A moment later the *Bulkeley* had disappeared, carrying down with her, in the vortex of swirling water, this gallant officer, who gave his life that another might live. (To perpetuate his memory, the Secretary of the Navy, a few months later, named a new destroyer in honor of Commander King.)

The remainder of the operation was completed without further serious accident.

From a standpoint of time, the results had been splendid; our rate of sweeping had actually been tripled. On the other hand, the casualties had been enormous—one ship sunk, one permanently disabled, three damaged so badly that docking was necessary, three forced to return to port for repairs, while three had been able to complete repairs on the mine field.

A careful review of the accidents, however, showed that the majority had been due to causes independent of the method of sweeping, and the rapidity with which they had occurred had been proportional to the number of mines destroyed per day; so, evidently the ultimate losses would be equal, and the preference lay decidedly with the more rapid method.

One thing, however, was apparent; it was not safe to sweep with trawlers. Although the British had successfully used

A FLOTILLA OF SUB-CHASERS AT REST

When these small but active war craft were in port they tied up alongside the repair ships in order to facilitate repairs, replenish their stores, and to give their crews as much relaxation as possible.

them for years, their structural strength was far too light to withstand the explosions of the American-made mines. Arrangements were therefore made to return thirteen of these vessels to the Admiralty, six being retained for transporting gear and supplies from Inverness to Kirkwall and for the delivery of sweeping material to the vessels on the mine field.

The new sweepers which the Admiral had requested in May now began to arrive, fortunately just in time to replace the vacancies caused by turning back the trawlers and the absence of the ships which had been crippled by explosions. Eight had reached Kirkwall within the week, so that now the total force consisted of 32 sweepers, 24 sub-chasers, and 6 trawlers, besides the two repair ships.

SWEEPERS SET NEW RECORDS

When all the vessels were in port the little harbor of Kirkwall bristled with activities, resembling more the busy harbor of New York than that isolated little village bordering on the Frigid Zone.

After five days in port the sweepers headed once more for the mine fields. The two groups designated to be cleared were finished in such record-breaking time that the sweepers asked permission to try to do two more before going back to port.

The Buoy-laying Squadron was rushed out to mark the new fields, but were no longer able to keep ahead of the sweepers, and another pair of vessels had to be added to their force.

At the end of sixteen days Groups 3, 5, 6, and 7 were all swept. The casualties had been remarkably light. Fifty-five per cent of the barrage was now cleared, and although it was the middle of August, with the best part of the summer gone and the days rapidly growing shorter, every officer and man was determined he would not give up until the last mine in the North Sea had been destroyed.

Of the remaining six groups, five were

WHILE CLEARING THE MINES BORDERING THE NORWEGIAN COAST THE SWEEPERS PUT INTO STAVANGER

This is a bustling little town, made prosperous by the war. The American mine-sweepers came here to obtain fresh water and redistribute their sweep-gear.

at the extreme eastern side of the barrage. The other, Group 8, began just off the entrance to Kirkwall, but could not be undertaken until the British had removed their line of mines, laid closely parallel to ours; for theirs, which were only six feet below the surface, were more dangerous to us than ours to them, and consequently should be undertaken first.

Four days sufficed this time for repairs and overhaul in port. To a man aboard a sweeper it seemed as if he lived continuously at sea; and for such small ships, too, it was indeed an enviable endurance record they were making.

Even the routine affairs of administration, which almost invariably take place in port, had to be conducted on the mine field. An interesting example of this occurred when the annual examination of enlisted men for promotion to warrant officers fell due.

A storm was raging at the time, making it impossible to sweep and equally impossible to transfer the candidates from their various vessels in order that they might appear before the examining board on the flagship; so that most valuable invention, the radio-telephone, was resorted to, and by this means each candidate was simultaneously asked the successive questions of the examination while he sat at a desk on his own ship.

A SHORTAGE OF KITES THREATENS THE WORK

Aside from the delays caused by the gales, which now came on in greater violence and frequency, the sweeping progressed without interruption or serious casualty. The speed at which we now were working, however, introduced a factor which threatened daily to delay us. Sweep-wire and kites—essential implements—were being used up faster than we could obtain them. Besides the steady shipments from the United States, British manufacturers were producing at their maximum capacity. We had already

BY SETTING THE STAYSAILS, IT FREQUENTLY WAS POSSIBLE TO ADD A KNOT OR TWO TO THE SPEED MADE GOOD IN EVEN THE WORST OF WEATHER

drained the Admiralty of all that they could spare, and still the supply was insufficient.

The two repair ships, *Black Hawk* and *Panther,* therefore, had to lay aside the construction and repair work for the sweepers and chasers and devote their energy to the manufacture of kites, to enable the sweepers to continue operating.

Throughout the entire sweeping of the barrage we never had sufficient gear at any time to equip fully all sweepers for their contemplated stay at sea, and so it frequently was necessary after the day's work was over for one vessel, whose expenditures had been comparatively light, to go alongside one less fortunate and divide the supply of kites and sweep-wire that remained.

A TASK FOR IRON CONSTITUTIONS

Buoys, too, for marking the new fields were equally in demand, and, in order not to lose any of the valuable hours of daylight which could be used for locating the positions of the markers, it frequently was necessary for the Buoy-laying Squadron to spend the entire night in going from one sweeper to another to gather up the buoys which had been weighed after the sweeping of a group had been completed.

Think of the physical endurance this

LIFE ON BOARD THE SUB-CHASERS WAS CONCENTRATED HARDSHIP

With the ships rolling and pitching incessantly, the crews lived largely on cold canned foods, slept in wet bunks, in unheated compartments, and sank mines as fast as the sweepers cut them up. Small as they are, the sub-chasers are marvelous sea boats and were able to stay out in weather that would have driven far larger vessels into port.

work required! The sweeping itself was fatiguing enough; it was an all-hands' job. But, after it was finished for the day, to spend a part, sometimes all, of the night in getting ready for the next day's work was a task for nothing less than iron constitutions.

Nothing could have been more magnificent than the splendid manner in which the officers and men stood up under the terrific strain. With never a murmur, never a complaint, sometimes going for months without setting foot on shore, these officers and men toiled on day after day.

A comparison of the British minesweepers with our own is interesting. Their crews consisted entirely of volunteers and were given nearly double pay, as well as a large bonus for each mine that they destroyed. We had no volunteers; it was the work of the Navy and we took it as such. We received no extra compensation nor any bonus for the mines that we destroyed.

On the 13th of September, 32 days after leaving Kirkwall, the fleet returned to port. Five and a half out of the six remaining groups had been completed. The British sweepers had not yet completed clearing their single line of mines to the southward of Group 8, and therefore only the northern half of our group could be cleared at that time. The British were expected to finish any day, after which we would be free to sweep the remainder of our group. When that was done Admiral Strauss desired to make a general test sweep of a large portion of the barrage to prove definitely that our work had been thoroughly done.

It was now the critical season of the

THE LAST TWO WEEKS OF MINE-SWEEPING WERE ACCOMPLISHED UNDER ALMOST SUPERHUMAN DIFFICULTIES

Storm followed storm with steadily increasing frequency and violence, until it seemed impossible that ships could actually be operating. The foremast of a sweeper can be seen in the center of the picture, while in the upper left-hand corner, perching on the crest of the wave, is the silhouette of a tiny sub-chaser.

year. A careful analysis of the meteorological records covering years of observation showed that in all probability the equinoctial storms could be expected within the next few days, and after they had broken the winter weather would set in with such fury that further operations would be practically impossible.

THE SWEEPERS ENCOUNTER A NORTH SEA STORM

Every minute must be saved. As soon as the ships had anchored the Admiral made a signal, asking how many could go out again at the end of three days. After 32 days at sea, it was asking a lot—more than could be expected, even of battleships—but in less than half an hour 23 of the sweepers reported that they would be ready! Actually, 28 of them managed to sail at the end of the third day.

Group 8 was finished in two days, but before the test sweep could be started the equinoctial storms bore down upon us with the violence of a hurricane. For three days the storm continued. The sweepers had sought shelter in the lee of Sanday Island, where the anchor chains of many snapped as if they had been made of cordage. In Kirkwall two of the ships were blown ashore and rescued only with the greatest difficulty. A large British transport, the *S. S. Vedic,* was driven on a reef a few miles north of where the sweepers lay and four of them were sent to her assistance.

DAYS OF MISERY

The following days were days of misery for the sweepers. Storm followed storm with such rapidity that the seas seemed ever to climb higher under the intermittent acceleration of the succeeding gales.

As long as it was possible to run before the seas, those sturdy little vessels would manage by one means or another

EVEN IN THE ROUGHEST WEATHER IT CONSTANTLY WAS NECESSARY FOR THE SHIPS TO GO ALONGSIDE EACH OTHER AT SEA TO TRANSFER SWEEP-GEAR OR BUOY MATERIAL

All hands were required to wear life-preservers, on account of the danger of being washed overboard by a mine explosion.

to rig out their sweeps. It seemed incredible that they could actually be working, as they perched for a moment on the crest of a wave, then disappeared almost from sight, as they slid into the hollows of the seas, pitching and rolling sometimes as much as fifty degrees each side of the vertical.

Still the work continued. The nights were even worse than the days, for then it was necessary to lie to, trying, sometimes vainly, to keep a tiny marker buoy in sight by playing a flickering searchlight on it, as the ship lurched to and fro, for it was imperative we should know our position in the morning.

THE DAY OF DAYS

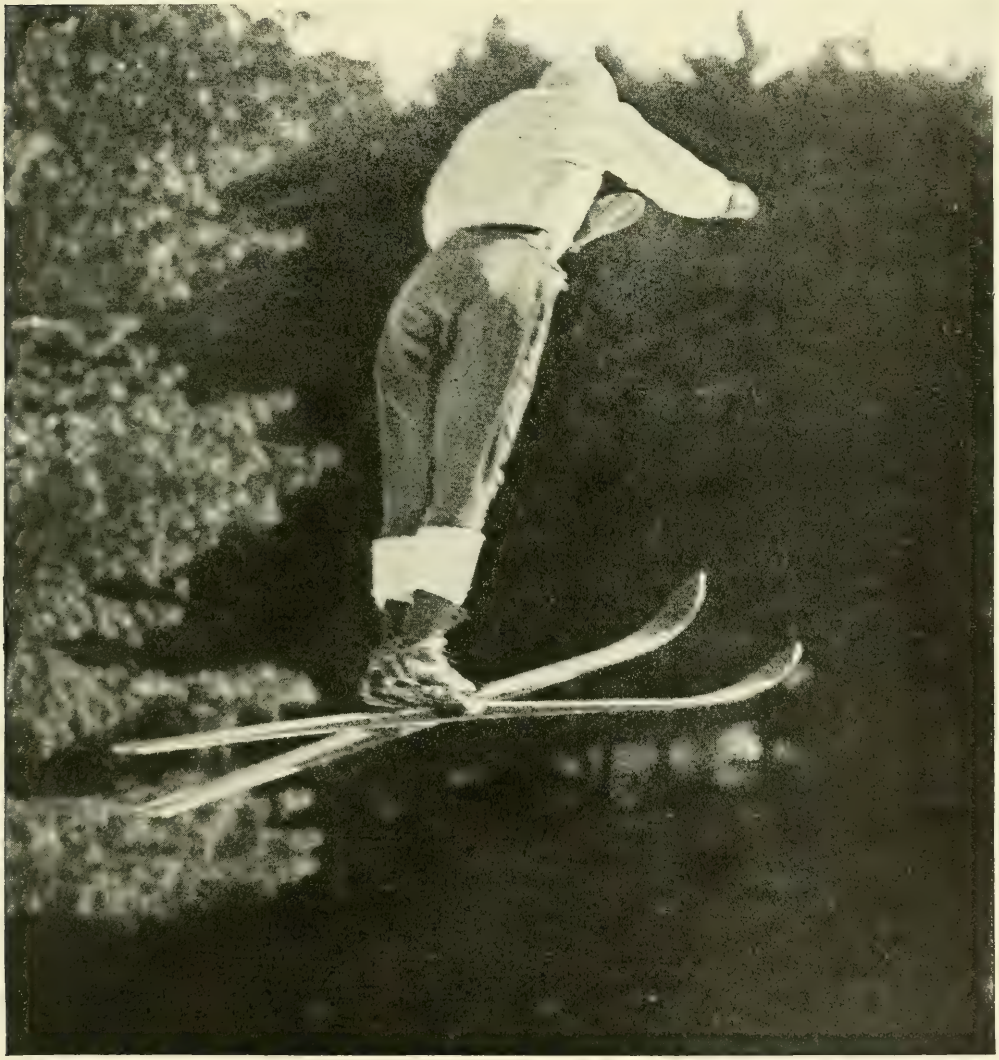
But at last our efforts were rewarded. That day of days came—the day which had at first seemed almost beyond attainment. And what a sight it was! The *Patuxent* had planted the last buoy, marking the goal of our ambition; and as the sweepers, pair by pair, steamed past it and slipped sweep for the last time, the exultation of the victorious conquest of an invisible enemy burst forth in wholehearted cheers from every officer and man.

Whistles and sirens, too, were opened wide, while a wireless operator with a humorous turn coupled a phonograph to the radio-telephone and regaled the fleet with the welcome strains of "Home, Sweet Home!"

During the last two weeks 864 square miles of the barrage had been reswept to make absolutely certain that the work had been thoroughly done. Where approximately 35,000 mines had been anchored a few months prior, not a single one could now be found, except in one small pocket which had been skipped and was marked by buoys to enable it to be cleared on this final operation.

The test sweep was conclusive that the work had been thorough. The sagacious judgment of the Admiral in driving the force to the limit of physical endurance, coupled with the unparalleled loyalty of the officers and men, had enabled that gigantic task to be completed just as the violent winter storms were making further operations throughout the North Sea impossible.

The mighty wall of mines which had confined the enemy's submarines and barred the commerce of the seas for better than a year had been destroyed, and the Navy's obligation to humanity, to the freedom of the seas, had been fulfilled.



Photograph by Kenneth D. Smith

A MEMBER OF THE DARTMOUTH OUTING CLUB SOARING ON SKIS: HANOVER, NEW HAMPSHIRE

For an account of this thrilling winter sport, fostered by the famous New England College, alma mater of Daniel Webster, Rufus Choate, George Ticknor, George P. Marsh, Thaddeus Stevens, and Chief Justice Salmon P. Chase, see article on page 151.

Photograph by Kenneth D. Smith

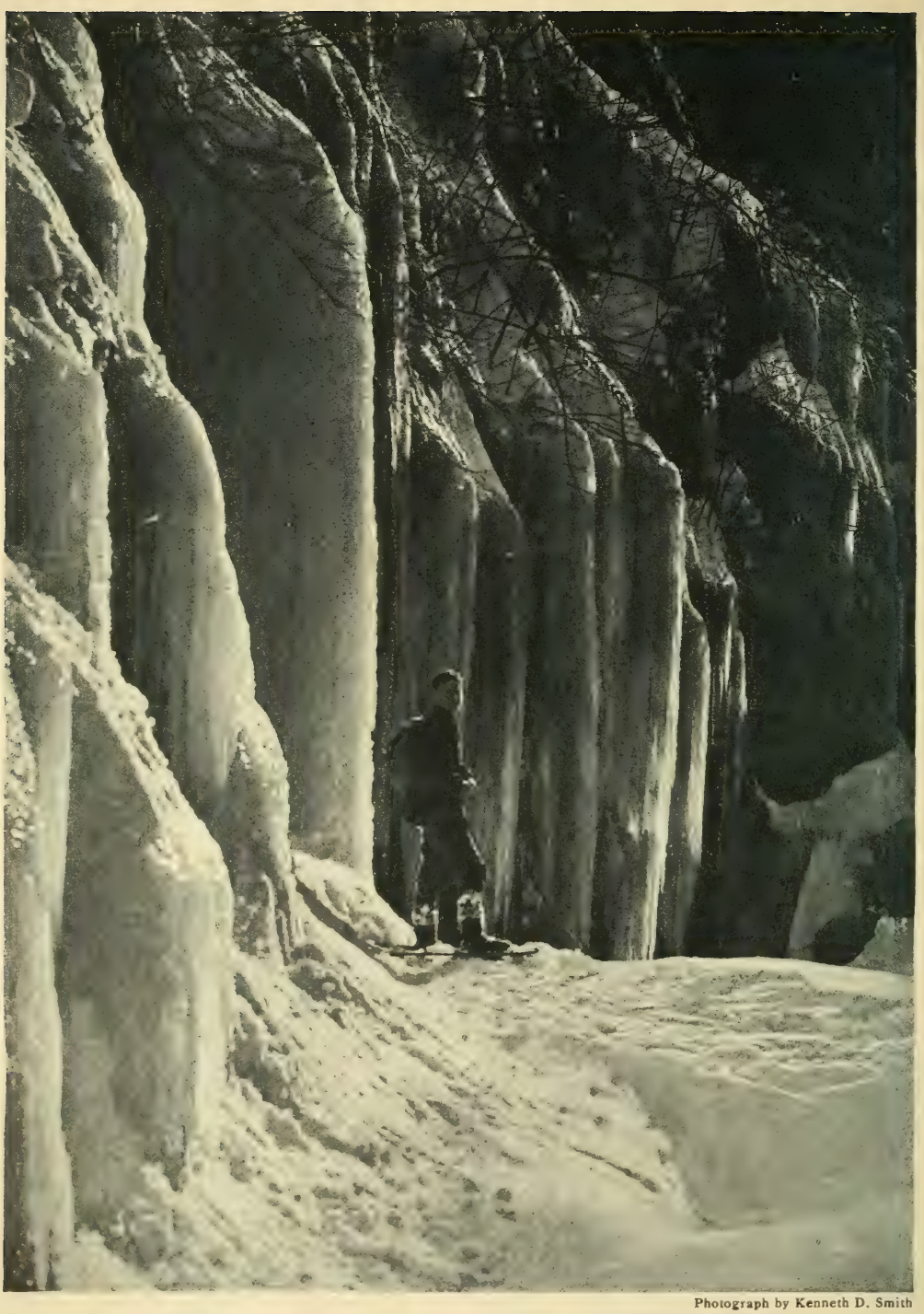
SKIING IN FRANCONIA NOTCH, NEW HAMPSHIRE

Three student members of the Dartmouth Outing Club starting for a long excursion over the frozen trail.

Photograph by Kenneth D. Smith

A LONE SKI RUNNER ON A WINDING TRAIL

The coming of winter does not drive the college man indoors. Rather it gives him a chance to exchange his football letter for the white badge of the Dartmouth Outing Club, which means long hikes to lovely scenes and long swift sweeps on skis down open fields of snow.



Photograph by Kenneth D. Smith

ICICLE FORMATION IN THE FLUME: NEW HAMPSHIRE

At this spot in the Franconia Mountains, a small stream flows between precipitous rocky walls, and the cold winds create wonderful ice formations from the water which filters down into this shadowy rift from the sunny slopes above.

Photograph by R. R. Sallows

THAWING OUT THE OLD PUMP

To the philosophic country-dweller, thawing out the pump whose throat has suffered from a night of exposure is as much a part of the day's work as "breaking out the roads" or blanketing the family Dobbin.

© R. W. Magee

THE CAPITOL AT NIGHT

When icy masses drape the evergreens and great gaunt limbs of the nation-old trees are edged in white, evening lights suffuse bright cheer across the glistening snow. Dark trees uprear their barren branches and frame within their iron-black tracery the leaden-hued dome of the National Capitol.

Photograph by Charles Martin

HOME OF THE PRESIDENTS IN WINTER. THE WHITE HOUSE: WASHINGTON

In none of the buildings of the Capital has the spirit of colonial America been so well preserved as in the White House, and when Washington is whitened with one of its infrequent snowfalls the Executive Mansion seems more of a home than ever. The equestrian statue of General Jackson is an interesting feature of the view from the President's front windows.

Photograph by J. Manning McLeod

A FORD IN AMERICA'S MOST BEAUTIFUL CITY PARK

Many residents of the Nation's Capital ride or tramp to the silent places along Rock Creek, from which the park takes its name, there to listen to the "tongues in trees, books in running brooks" and "sermons in stones." As darkness falls, the timber wolves, confined near by, call loudly to their departed sires across the wide reaches of time, and only the churning of the motor cars rushing through the ford now and then remind one that a large city overhangs the spot.

© Photograph by Haynes (St. Paul), 1919

THE NORRIS GEYSER BASIN IN WINTER: YELLOWSTONE PARK

These geysers form a versatile troupe. Monarch, the largest, is exceedingly irregular, but gives notable exhibitions on occasion. Minute Man is much smaller, but has won its name for frequent eruptions. Constant is active much of the time and Hurricane, still smaller, is continuous. Because the geysers of the Norris Basin allow artistic temperament to prevent a reliable exhibition schedule, it is small wonder that the thousands of tourists prefer to go on to witness the really splendid and regular eruptions of Old Faithful.

Photograph by Donald B. MacMillan

THE GEOGRAPHIC EXPLORER BUILDING A SNOW SHELTER FOR THE NIGHT

When the day's trail is ended, great blocks of snow, carved from the all-encompassing cold, must be formed into a rude shelter to keep out the bitter wind of the frozen north.

Photograph by Donald B. MacMillan

THE MONARCH OF THE NORTH, MAJESTIC IN HIS CALM THOUGH RINGED ABOUT BY FOES

The photographer has caught the dramatic moment when the polar king is debating whether to give battle or to flee. His massive form stands steady as the berg of which he seems a part while he awaits attack.

Photograph by Curtis & Miller

A NATURAL LOOKOUT FROM MOUNT BAKER, WASHINGTON

From the 10,800-foot summit of this isolated offshoot of the Cascade Mountains one can look over into Canada, for Mount Baker is one of the northernmost peaks of the United States. It is a massive volcanic cone, but has been quiescent for half a century. The view from its summit embraces winding rivers and snow-clad mountains, sparkling Mosquito Lake and primeval forest.

Photograph by Jean Gaberell

THE FRIENDLINESS OF TREE AND SNOW

When snow and frost give life to the dead black of the autumn branches, the trees frame vistas which are beautiful because the snow lies thick on cabin roof and mountain slope, softening all harsh lines. Just as the spring sun allows his ardent glance to be hidden by a leafy bower, so the modest willow and the sturdy ash efface themselves before the distant scene which their bare branches frame.

Photograph by A. E. Churchill

NEW YORK CITY DURING A SNOWSTORM

When heavy snowfall drives Manhattan's traffic to subway and elevated, the call goes forth for men to battle with the white army of the elements whose enveloping movement threatens surface traffic. Then the scene on lower Fifth Avenue presents a truly wintry picture.

Photograph from Detroit News

DETROIT'S WEDDING-CAKE ICE FOUNTAIN

In Washington Boulevard at Michigan Avenue, Jack Frost and the Detroit City Water Works collaborate in the erection of this towering crystal confection, the beauty of which is as unstudied as if it were some natural geyser transfixed by the breath of Boreas in some remote wilderness instead of in a city park.

Photograph by Ernest Fox

NIAGARA FALLS IN ITS WINTER ARMOR

Impressive as Niagara is when its rush of waters appals the beholder and clouds of spray rise from the chaos, in the midst of which a cockle-shell boat impudently noses the flood, it does not surpass the view in winter when the Frost King has spanned the river with heaving masses of ice and concealed behind alabaster columns the mighty torrent as it thunders toward the sea.

Photograph by A. J. Baker

SPERRY CAMP IN GLACIER NATIONAL PARK

What is more beautiful than a distant mountain peak poised majestically on a "throne of rocks, in a robe of clouds, with a diadem of snow"? In winter, when the mass of driven white stretches unbroken from the lofty summit to the timber line, there is a grandeur that no other mood of the mountain conveys.

Photograph by A. B. Wilse

A FROSTY MORNING ON THE OPEN ROAD

What Spanish moss is to the trees of the far South, the frosty touch of winter is to the roadside trees of the colder North. Shiny trails which bright steel runners make and hard pressed lumps of snow, thrown from the flying feet of man's best friend, mark the journey past such lovely scenes to warmth and comfort by the blazing fire within the home.

SKIING OVER THE NEW HAMPSHIRE HILLS

A Thrilling and Picturesque Sport Which Has a Thousand Devotees in the Dartmouth Outing Club

By Fred H. Harris

CLIMATE and geography mold the sports of colleges as well as of nations.

The fact that Dartmouth College is situated in the sequestered town of Hanover, New Hampshire, among the foothills of the White Mountains, where the hand of winter lies heavy on the land during a large part of the scholastic year, is responsible for the organization of an athletic association unique in the annals of student life in America.

Unlike football, baseball, hockey, and basket-ball teams, each of which in its ultimate development enlists the active efforts at play of a limited number of athletes, the Dartmouth Outing Club is composed of more than a thousand members—nearly two-thirds of the entire student body.

The long months of cold and the deep snows that serve to isolate this college community have, through the Outing Club, been converted into an asset rather than a liability, and today Dartmouth is a pioneer institution in the movement to enlist the entire student body in healthful sport, instead of offering the college "letter" only to those whose physical prowess is proved.

In the Outing Club all who love the wide spaces, all who delight in the stillness of the winter woods, all who feel the lure of the frozen trail, are welcomed as of the elect.

THE CLUB'S EARLY EXCURSIONS

Beginning modestly, with sixty members a few years ago, the Club in its incipiency confined its excursions to Saturday afternoon jaunts on skis and snowshoes. Toward the end of the afternoon a halt would be called and coffee made over a crackling fire, under the shelter of snow-laden trees. The trips grew in frequency and the parties grew in number. By the end of the first season scores of students had become interested in the excursions, and, as Thoreau said of his Concord, the members "had traveled a great deal in the vicinity of Hanover."

Today the Saturday afternoon trips of old have expanded into week-end journeys; the radius of the excursions has increased from a few miles to tens of miles, and instead of confining their explorations to the foothills along the banks of the frozen Connecticut, the enthusiasts now make Mount Washington, the highest peak of the North Atlantic States, their furthest objective. The camp-fire of crackling twigs under the trees has been superseded by the cheerful glow of logs in the open fireplaces of comfortable cabins, which shelter those who wish to extend their outing overnight.

BUILDING A CHAIN OF CABINS

The first of the chain of cabins for the week-end devotees of the Outing Club was established on the site of an old lumber camp at the base of Moose Mountain, seven miles from the college. Built through the efforts of a dozen club members who elected to spend their Easter vacation as carpenters, and through the material assistance of a Boston alumnus, Franklin P. Shumway, its immediate popularity was so pronounced that no propaganda was necessary to insure the enthusiastic support of the student body for the movement subsequently inaugurated by another alumnus, the Rev. J. E. Johnson, of Philadelphia.

Mr. Johnson has raised an endowment fund of $40,000 for the construction and maintenance of these combination rest-cabins and rustic club-houses which extend, at intervals of a day's trip apart, from the college campus to the slopes of the White Mountains.

Close beside Moose Mountain Cabin flows a brook which has been dammed to form a deep pool, and the fact that this

Photograph by Fred H. Harris

COMING THROUGH WOODS WITHOUT CAPS OR SHIRTS

Not only has the Outing Club improved the physical well-being of Dartmouth's student body, but faculty statistics show that scholarship has profited by the week-end excursions of skiing parties.

Photograph by Kenneth D. Smith

SHOOTING THE SNOW CHUTES ON A SHOVEL

A novel way of traversing the skiing course to the landing stage of the big jump at Hanover.

Photograph by Fred H. Harris

READY FOR THE WINTER ASCENT OF THE TALLEST PEAK IN THE NORTH ATLANTIC STATES

Until the feat was actually accomplished by Dartmouth students, a ski climb to the summit of Mount Washington was considered impossible.

Photograph by Kenneth D. Smith

"THE BEST DRINK ON EARTH"

After skiing for fifteen or twenty miles without drinking, one appreciates water. Drinking out of Profile Lake, in Franconia Notch, White Mountains.

WHEN THE HOLLOWS OF THE WOOD ARE COVERED WITH WINTER'S CARPET

Photographs by Fred H. Harris

THE OLD SWIMMIN'-HOLE IN A NEW MOOD

Here is a test of bodily vigor which few city dwellers would care to undergo. Near the Moose Mount Cabin of the Dartmouth Outing Club the members have dammed a small brook to make this winter open-air bath. It is usually necessary to break a sheet of ice before the bather can take his plunge.

Photograph by Kenneth D. Smith

MEMBERS OF THE DARTMOUTH OUTING CLUB ON TOP OF MOUNT LAFAYETTE: ONE OF THE ANNUAL WINTER PILGRIMAGES OF THE TRAIL-FOLLOWERS

Photographs by Fred H. Harris

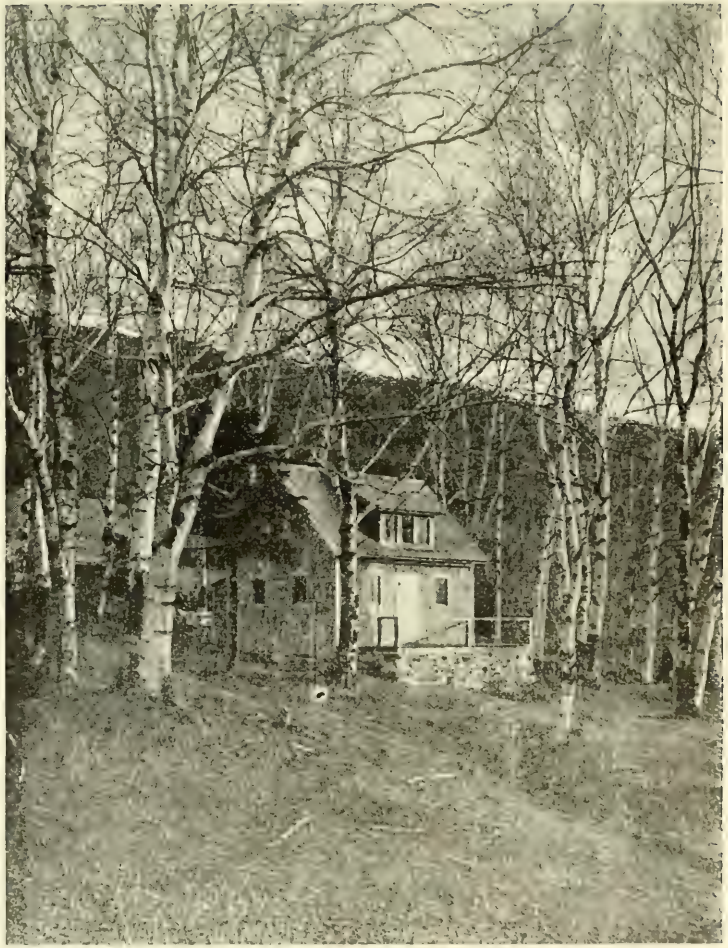
SLEEPING ON THE FLOOR OF ONE OF THE CABINS

Gathered about the roaring logs of an open fireplace, these Dartmouth Outing Club enthusiasts do not even demand the comfort of bunks.

Photograph by Kenneth D. Smith

NEARLY SUNDOWN IN THE NEW HAMPSHIRE WOODS

A solitary student skiing along the banks of the Connecticut a mile from Dartmouth College.



Photographs from Fred H. Harris

THE LAST CABIN OF THE CHAIN

A big open fireplace and enough bunks to accommodate thirty tired hikers are the chief architectural features of these Dartmouth Outing Club camps. A cooking-stove is also installed in each cabin.

THE CUBE MOUNT CABIN, IN A GROVE OF BIRCHES

It is the law of the trail that each party shall leave a supply of dry logs stacked against the chimney, for the use of the next traveler who happens along.

open-air bath, available only after the thick crust of ice is broken, is in use throughout the severest winter weather needs no commentary to prove the hardihood which the Outing Club engenders in some of its members.

THE MEANDERINGS OF THE TRAIL

An Outing Club trail from Hanover to the White Mountains is a skiway leading through grandeurs of winter scenery wholly unknown to those who nestle beside steam radiators and gaze out upon a world blanketed in white, or who gain their sole idea of a snowclad landscape through the windows of automobile or swift-flying train.

Sometimes the trail, in companionable fashion, follows some meandering back-country road; then it dips off suddenly into the forest to seek solitude in the solemnity of Nature's cathedral trees. It descends into deep ravines, it mounts billowing slopes of white; sometimes it skirts the edge of a logging camp desolate in its evidences of former habitation. Now it runs straight over hedge and copse, now it sinuously mounts a gleaming summit from whose eminence the winter world unfolds in all its splendor.

Twenty-three miles beyond Moose Mountain Cabin stands the Cube Mount Station, tucked away in a grove of white birches, with the evergreen slopes of the mountain rising as a background for the picture. To the west the noble panorama of the Green Mountains unfolds along the Vermont skyline.

Sheltered by a cluster of whispering pines on the eastern shore of Armington Pond, a third cabin is built in the shadow of Piermont Mountain, which rises abruptly on the opposite shore. A short walk from the cabin is the famous Lake Tarleton Club, and some distance further along the trail which winds through Webster Slide is the Great Bear Cabin, deriving its name from the fact that students who were prospecting for the site found the tracks of a black bear in the neighborhood.

A FIVE-MILE SLIDE

Over the shoulder of Mount Moosilauke goes the traveler after he leaves Great Bear Cabin, and from this eminence the ski sportsman has one of the most delightful experiences of his excursion, as he slides almost without effort for a distance of five miles to the picturesque hamlet of Wildwood.

One of the most popular camps of the Dartmouth Club is located in the famous Agassiz Basin, ever to be associated with the great naturalist's elaboration of his theory of glaciers. Here is the Lost River District, little known to the average White Mountain tourist of the summer season, but one of the most interesting regions of the New England States.

Lost River is important for what it has been rather than for what it is. In the distant past great torrents of water from a melting glacier flowed here, and once an earthquake shattered the mountainside, hurling huge boulders into the bed of the river, practically burying the stream. Immense "potholes" were carved in the rocks by the action of the water, enabling the student of geology to read aright the sermons which that mystic, Nature, has written in the stones.

Near the point where the river disappears for its journey of a quarter of a mile underground is the cosy club-house of the Society for the Preservation of New Hampshire Forests.

THE PAGEANT OF THE PRESIDENTIAL RANGE

After passing North Woodstock, which lies beyond Agassiz Basin, the Outing clubman comes to Profile Notch, with its famous "Old Man of the Mountains." Then for a swift slide down Three-mile Hill to Franconia, north to Littleton, to Manns Hill, and finally to Skyline Farm, where ends the trail. Here the whole pageant of the Presidential Range of mountains is spread before the view of the winter visitor—a matchless picture of serrated summits and tree-clad slopes wrapped in an Arctic mantle of iridescent beauty.

But hiking is not the be-all and the end-all of the Dartmouth Outing Club. There is the spectacular Winter Carnival, staged for the delight of the friends of the students as well as for their own pleasure.

During this "Mardi Gras of the North"

Photograph by Kenneth D. Smith

MARIAN FAIRFIELD, OF HANOVER, AT THE MOMENT OF LANDING FROM A SKI JUMP

This young miss has just gone over the "big jump" of the Dartmouth College skiing course—a feat which many experienced athletes have refused to attempt.

there is a succession of spirited races—ski and snowshoe sprints, cross-country ski races, testing the stamina of the contestants as do few other college sports, and obstacle races.

The crowning event of the carnival, however, is the ski-jumping contest, which is to the occasion what the chariot race of the Olympic games was to the ancients. Thousands of spectators can be accommodated on the slopes surrounding Dartmouth's great ski-jumping course.

THE SKI-JUMPING COURSE

The approach of the ski-jump is down a steep 300-foot pathway cut through a pine forest. At the top is a wooden trestle, which enables the contestant to acquire a tremendous initial momentum for his rush down the course to the "jump" itself, which is a level platform

Photograph by Kenneth D. Smith

A SKI DASH, ONE OF THE MANY RACING EVENTS OF THE ANNUAL WINTER CARNIVAL HELD BY THE DARTMOUTH OUTING CLUB: HANOVER, NEW HAMPSHIRE

fifty feet long, with a "take-off" eight feet above the slope.

The steep slopes of the hill have been so terraced that the spectators are enabled to get a close view of the jumper from the moment he begins his spectacular slide.

Poised 150 feet above the heads of the onlookers, the contestant hesitates for a moment, breathes deeply, and then waits with every muscle taut and every nerve atingle for the signal. It is given. Instantly he tips over the brink of the trestle, at the same time assuming the crouching position which offers the least possible wind resistance to his flight.

As he sweeps down the glassy incline he keeps his body in perfect balance, his skis together and parallel. As he gains impetus he resembles a human missile shot from some gigantic catapult.

WHAT WILL HAPPEN WHEN HE HITS?

Out upon the jumping platform he slides with lightning speed, and at the critical moment, with all the strength of his lithe body concentrated in his knees, he springs. Like a soaring bird, he launches upward and out into space. For a moment he seems to pause in midair, then quickly describing an arc, down, down, down, he swoops with the speed of thought.

What will happen when he hits? This is the harrowing question which comes to the mind of every spectator who is watching the thrilling sport for the first time. But he does not *hit;* he seems merely to *meet* the snow track at the bottom of the jump. And that is exactly what does happen; for, as the jumper rushes through space, he is describing a curve of thirty degrees, and the track is so arranged that at the point where he alights the slope also inclines at an angle of thirty degrees, and the moment of contact is thus robbed of all its shock.

The jumper, provided he alights with his skis together and at the correct angle, simply glides on, at terrific speed, until, with a perfectly executed telemark swing, he brings himself to a halt in a whirl of snow.

These contests do not take place among the students of Dartmouth only. McGill College, of Montreal, Canada, frequently

sends a team of jumpers to the carnival, when the struggle for supremacy assumes an intercollegiate and an international flavor.

EXECUTING A SOMERSAULT ON SKIS

Every jump brings a thrill to spectator as well as to participant, but the supreme moment of the carnival comes when a master of the skis executes some such spectacular antic in the air as a forward somersault.

As the stellar performer prepares for the jump, a hush sweeps over the spectators, for every one knows that unless his timing is accurate to the fraction of a second and his spring from the platform is perfect, contusions and broken bones will be his reward.

Down he rushes to the platform. A sudden contraction of all the muscles of the body, a magnificent leap into the air, a somersault completed at the instant of landing—all in the time of a held breath! There is wild applause from the relieved spectators, as they realize that the sensational "stunt" is successfully accomplished.

In many respects ski jumping is an even more exhilarating sport than flying. As one shoots out and down through the keen, bracing air with no windshield to protect him, the sensation is beyond description. Unlike the aviator, the ski jumper has no ailerons, no rudder, no "flippers" to aid him. The whole success of the venture depends solely upon the human machine, upon the proper coördination of the muscles and upon the ability of the jumper to judge with absolute accuracy the precise moment for the spring.

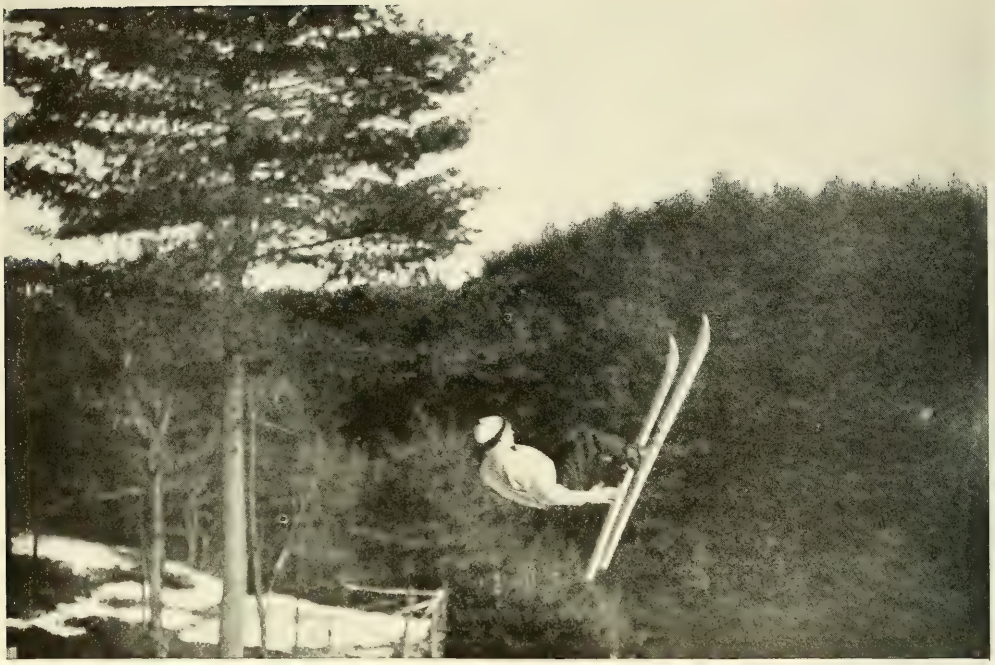
SKIING UP AND DOWN MT. WASHINGTON

When the snows begin to melt around Hanover in the spring the Outing Club gives its final winter party—a three days' trip into the White Mountains. From headquarters at the foot of Mount Washington, the sportsmen climb the mountain, plunge into Tuckerman's Ravine, and see aspects of the outdoors which are never revealed to summer visitors. The snows have begun to disappear in the southern portion of the State, but drifts to a depth of 100 feet in the ravines are still to be found here.

Photograph by Kenneth D. Smith

FRONT VIEW OF A SKI JUMPER IN FLIGHT

Not even aviation can provide more thrilling sport than that afforded the expert on skis.



© E. G. Dewey

SOMERSAULTING THROUGH SPACE ON SKIS

The first of a remarkable series of photographs illustrating one of the most thrilling exhibitions of the mid-winter carnival at Hanover, New Hampshire.

© E. G. Dewey

THE SOMERSAULT HALF COMPLETED

This spectacular test of skill is accomplished in a few seconds, but it provides the thousands of spectators a topic of conversation for months.

© E. G. Dewey

THE THIRD EVOLUTION OF THE SOMERSAULT

One of America's foremost adepts in the performance of this "stunt de luxe" is a Dartmouth sophomore, John Carelton.

© E. G. Dewey

HE WILL BE HEAD-UP WHEN HIS SKIS TOUCH THE SLOPE

The ability to judge the exact moment for the leap into the air while traveling at the rate of forty miles an hour is an essential factor in the successful accomplishment of this feat. The knees act as shock-absorbers.

Photograph by Dr. Leland Griggs

ALL OFF TOGETHER

A ski threesome takes the air for the downward drop at the Dartmouth "Mardi Gras of the North."

On several occasions members of the Club have succeeded in climbing on skis to the summit of Mount Washington, a feat which, until accomplished by these Dartmouth students, was deemed impossible.

The difficulty of the ascent is not to be discounted by its accomplishment, however; and the descent, especially down the icy, wind-driven slopes above the tree line, is an even more hazardous test of skill.

Usually the ski men rope themselves together like the scalers of Alpine crags; but, once over the dangerous part of the course, the stalwart mountaineers find rare delight in the long glide down the carriage road from Half-way House.

The start for this last fascinating stage of the trip is usually made in the late afternoon, when the light is fading and the snow particles come hissing down from the heights, bringing with them a penetrating cold.

Now there is no inclination on the part of the travelers to tarry. With a vigorous push of the ski poles, the rush begins.

On the steep slope the speed is quickly accelerated to forty miles an hour, as the skis sing and whistle over the snow. On through the woods, at ever-quickening pace, the hikers go, sometimes forced from the path by the rapidity with which they take the curves in the road. Not infrequently there is a spill in the snow, as the moon casts deceptive shadows along the way.

Now and again the incline flattens out almost to a plane and the pace slackens instantly, but in another hundred yards the traveler is again speeding before his shadow.

It is a wonderful course, 21,120 feet in length, with a drop of 2,000 feet, and a member of the Dartmouth Outing Club has set a record of twelve and a half minutes for the journey!

WINTER RAMBLES IN THOREAU'S COUNTRY

By Herbert W. Gleason

Author of "Through the Year with Thoreau"

With Illustrations from Photographs by the Author

"I have traveled a great deal in Concord."—Thoreau.

The National Geographic Magazine being pre-eminently a magazine of travel, it is not inappropriate to call the attention of its readers to the journeyings of one of the most original, observant, and wholly entertaining travelers whom the continent of America has produced. To be sure, his travels did not cover a very wide field, geographically; they consisted chiefly of daily walks afield or boating trips on the river to various points in his immediate neighborhood; yet they resulted in giving to his name a higher place in the temple of fame than that of many another who has roamed the seven seas and encompassed the ends of the earth.

Henry David Thoreau was born in Concord, Massachusetts, a little more than a century ago, and, with the exception of a few brief and unimportant excursions away from home, his entire life of forty-five years was spent within the confines of his native town.

So far, however, from lamenting this as a misfortune, he actually gloried in the supposed limitation. "It takes a man of genius," he declared, "to travel in his own country, in his native village; to make any progress between his door and his gate. If a man is rich and strong anywhere," he confided to his journal, "it must be on his native soil. Here I have been these forty years, learning the language of these fields that I may the better express myself.

PREFERRED HIS OWN VILLAGE TO THE PROUDEST PARIS

"If I should travel to the prairies, I should much less understand them, and my past life would serve me but ill to describe them. Many a weed here stands for more of life to me than the big trees of California would if I should go there."

Somebody once suggested to him a trip to Paris. But why should he go to Paris? "It would be a wretched bargain to accept the proudest Paris in exchange for my native village. At best, Paris could only be a school in which to learn to live here, a stepping-stone to Concord, a school in which to fit for this university."

"THE ONLY TRAVEL THAT IS GOOD"

And so he records his solemn conviction: "If these fields and streams and woods, the phenomena of nature here, and the simple occupations of the inhabitants should cease to interest and inspire me, no culture or wealth would atone for the loss."

> "My feet forever stand
> On Concord fields,
> And I must live the life
> Which their soil yields."

Now, all this, of course, is at a wide remove from commonly accepted ideas, and many a Cook's tourist will smile superciliously on reading this pronunciamento of a confirmed stay-at-home. Yet Thoreau never meant to disparage foreign travel, as such. Indeed, from his own account it may fairly be assumed that his familiarity with the best books of travel far exceeded that of most people of his time, and certainly few people of any time have possessed, both by nature and training, a keener appreciation of the advantages which travel brings.

He was simply trying to enforce, in somewhat vigorous fashion, the truth that to a man with receptive mind and studious purpose there is to be found in his immediate environment a richness of experience and a depth of satisfaction which cannot be had in diffuse wanderings, however extended. "Only that travel is good," he claimed, "which reveals to me the value of home and enables me to enjoy it better."

OPENING OF THE RIVER CHANNEL: MASSACHUSETTS

Thoreau was always prompt to note the least promise of the coming spring, and the date when the first openings appeared in the ice of the river was duly recorded. The view in the photograph is looking upstream toward Fair Haven Hill.

WALDEN POND FROM THE SITE OF THOREAU'S HOUSE

Walden Pond, by the shore of which Thoreau built his famous cabin (memorialized by the cairn of stones in the foreground of the picture), has changed but little since his day and is still beautiful, both in winter and in summer.

ICICLE "ORGAN-PIPES"

The water from melting snow, trickling down over a perpendicular rock-face, freezes at night and "builds great organ-pipes of a ringed structure, which run together, buttressing the rock" (see page 179).

FROST CRYSTALS ON THE ICE

"They look like a loose web of small white feathers sprinkled from a tuft of down, as if a feather bed had been shaken over the ice. They are surprisingly perfect leaves, like ferns" (see page 175).

FANTASTIC SNOW-DRIFTS

In the ice of open stone walls, the wind, blowing through the chinks, carves the snow into many novel and picturesque forms. "This is the architecture of the snow."

Thoreau found such endless charm in the mystery and beauty of Concord fields and woods, so many fascinating problems requiring solution, such infinite variety in flower and bird and butterfly, such fresh delight in watching the progress of the seasons, as well as so much food for thought and inspiration in the human life around him, that he had no time for foreign travel. And for this he is sincerely grateful.

"I cannot but regard it," he says, "as a kindness in those who have the steering of me that, by the want of pecuniary wealth, I have been nailed down to this my native region so long and steadily, and made to study and love this spot of earth more and more. What would signify in comparison a thin and diffused love and knowledge of the whole earth instead, got by wandering?"

And there was a providence in this for others besides Thoreau. With his rare powers of observation, his innate sympathy with Nature, his keen sensitiveness to beauty wherever found, and his wonderful gift of verbal description, he has given us an unsurpassed picture of New England outdoor life which is destined to afford enjoyment and inspiration to thousands of people through all the years to come. It goes without saying that he never could have drawn this picture had he given much of his time to travel abroad.

Louisa Alcott, in her beautiful poem on "Thoreau's Flute," put the matter concisely:

> "Above man's aims his nature rose.
> The wisdom of a just content
> Made one small spot a continent,
> And tuned to poetry life's prose."

FOLLOWING THOREAU'S FOOTPATHS

It has been the writer's esteemed privilege during the past fifteen years and more to make many rambling trips to Concord, lured thither by Thoreau's vivid descriptions of Nature's beauty in his home surroundings. Without purposely attempting to repeat Thoreau's "travels," there has been found a peculiar pleasure in seeking out his favorite haunts, identifying places with which he was closely associated and which he named after a fashion of his own, and at the same time securing photographs of a great number of the actual scenes and phenomena in which he delighted.

These trips have been undertaken in all seasons of the year, coinciding so far as possible with Thoreau's own records and duplicating to a large degree many of his most enjoyable experiences. Especially has the winter season, which to many people is so burdensome and even repellant, proved wonderfully fruitful in subjects of interest and beauty.

DAYS OF NEW OPPORTUNITY

Thoreau was an enthusiast over the New England winter. He hailed its advent, noted every step of its progress, and found much of interest even in its lingering departure. At the close of the long, cold winter of 1855-56, with its record of ninety-nine consecutive days of sleighing in Concord—a period, one would think, long enough to upset the complacency of a man like Thoreau—he wrote, under date of April 10: "I look with more than respect, if not with regret, on its last dissolving traces."

There was something in winter's bareness and ruggedness, its simplicity and severity, its imperative challenge and its unexplored grandeur, which appealed irresistibly to his stalwart soul. And even stronger was the appeal to his esthetic sense. He never ceased to adore the spotless purity of the snow. Every snowstorm was a fresh revelation to him of Nature's inexhaustible beauty.

Days of intense cold were days of new opportunity to him. He was abroad in all kinds of weather, in all degrees of frost. The ice of the ponds and river he was diligent in exploring, both superficially and in its interior structure, and he was rewarded with exquisite displays of crystallization which very few people are ever privileged to see. Indeed, so extended and minute were his studies of winter's varying aspects that he could say on one occasion, as Emerson pleasantly relates, when returning a copy of Kane's "Arctic Explorations" which had been loaned to him, that "most of the phenomena noted might be observed in Concord!"

The winter climate of New England has been much reviled on account of its

A WINTER SUNSET FROM FAIR HAVEN HILL

On many a cold winter's day Thoreau would trudge a mile and a half through the snow to the top of this hill just to enjoy the sunset hour. "The man is blessed who every day is permitted to behold anything so pure and serene as the western sky at sunset."

EAST FROM NASHAWTUC HILL.

In pre-colonial times this hill was the residence of a famous Indian chief. Although of slight elevation, the views from its summit in all directions are very pleasing.

being so capricious. Sleet, slush, snow, hail, rain, freezing, thawing, blizzards, and sunshine make up a program which certainly does not lack in point of variety. Yet to this very fact is due much of the beauty of the New England winter. Were the cold uniform, did the snow which falls in December remain until April—conditions which obtain in certain other parts of the continent—the winter would lose a good part of its charm.

The winters in Concord today are just as changeful as in Thoreau's time, and one finds the same succession of varied phenomena which compelled his wonder and admiration.

WONDER IN THE WEAVING OF THE SNOW BLANKET

First of all, of course, there is the snow "blanket" enwrapping the earth, which to Thoreau was so suggestive both of utility and beauty—"a pure garment, as of white watered satin, over all the fields." There is wonderful fascination in the weaving of this blanket. The falling snow—what an incredible spectacle to one who has never seen it! And how the mystery and witchery of it persist even after one has seen it a thousand times!

To go abroad in Concord fields and woods during a snow storm is a memorable experience, especially if the snow is a little damp and clings to the trees and bushes in masses. Thoreau devotes many pages of enthusiastic description to a "lodging snow":

"The woods were incredibly fair, white as alabaster. Indeed, the young pines reminded you of the purest statuary, and the full-grown ones towering around affected you as if you stood in a titanic sculptor's studio, so purely and delicately white, transmitting the light. . . .

"Imagine the innumerable twigs and boughs of the forest crossing each other at every conceivable angle on every side, from the ground to thirty feet in height, with each its zigzag wall of snow four or five inches high, so innumerable at different distances one behind another that they completely close up the view, like a loose-woven downy screen."

And then, after the snow has fallen and the sun shines once more, the wind takes up the snow and whirls it into drifts, burying the fences and choking the highways. In the lee of open stone walls these drifts become curiously fantastic, the snow being carved by the wind, which whistles through the chinks in the wall into many novel and picturesque forms. "It builds up a fantastic wall behind the first — a snowy sierra. Astonishingly sharp and thin overhanging eaves it builds, even this dry snow, where it has the least suggestion from a wall or bank—less than a mason ever springs his brick from. This is the architecture of the snow."

With the coming of the sun, too, there appear those exquisite blue shadows on the snow. Given the right conditions of atmosphere and temperature, these shadows are captivating to every one who possesses the least sense of color values. What makes them so blue—"celestial blue"? "I think I never saw," says Thoreau, "a more Elysian blue than my shadow. I am turned into a tall blue Persian from my cap to my boots, such as no mortal can produce, with an amethystine hatchet in my hand. I am in raptures at my own shadow. What if the substance were of as ethereal a nature?"

READING THE SECRETS OF THE WILD

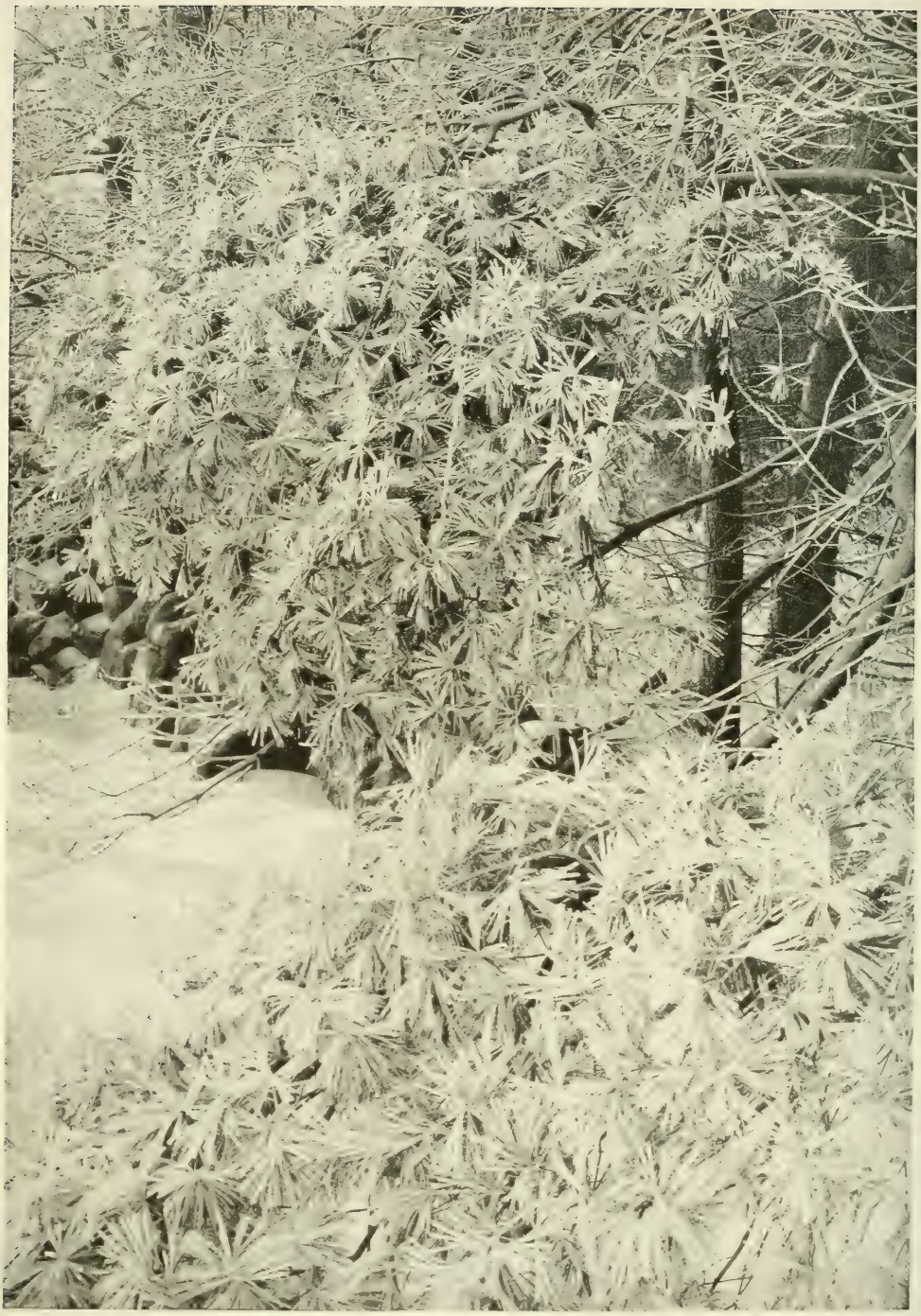
In his tramps afield after every fresh snowfall Thoreau took keen delight in reading the story of the wild life of the woods found in the tracks of fox and otter, squirrel and rabbit, crow and partridge, mouse and mink. The snow, he declared, is the great revealer, and he learned many secrets of the wild in these footprint studies.

Of all the denizens of the woods, however, Reynard held for him the greatest interest, and more than once he would spend a large portion of the day following the tracks of a fox and unraveling the record of its wanderings. Concord is so far from being wholly urbanized in these days that the wood-folk still linger within its precincts, and judging from the snowy tale of their gambols and journeyings they are scarcely less numerous than in Thoreau's time.

But Thoreau held that we may find in

AFTER AN ICE-STORM: MASSACHUSETTS

"Seen at the right angle, each ice-encrusted stubble shines like a prism with some color of the rainbow. What a crash of jewels as you walk!"



PINE FOLIAGE AFTER AN ICE-STORM

"The pines are as white as a counterpane, with raised embroidery and white tassels and fringes. Each fascicle of leaves or needles is held apart by an icy club surmounted by a little snowy or icy ball."

the snow the footprint of a life superior to anything of which zoölogy takes cognizance. "Why do the vast plains give us pleasure," he asks, "the twilight of the bent and half-buried woods? Is not all there consonant with virtue, justice, purity, courage, magnanimity? Are we not cheered by the sight? And does not all this amount to the track of a higher life than the otter's, a life which has not gone by and left a footprint merely, but is there with its beauty, its music, its perfume, its sweetness, to exhilarate and recreate us?

"Did this great snow come to reveal the track merely of some timorous hare, or of the Great Hare whose track no hunter has seen?"

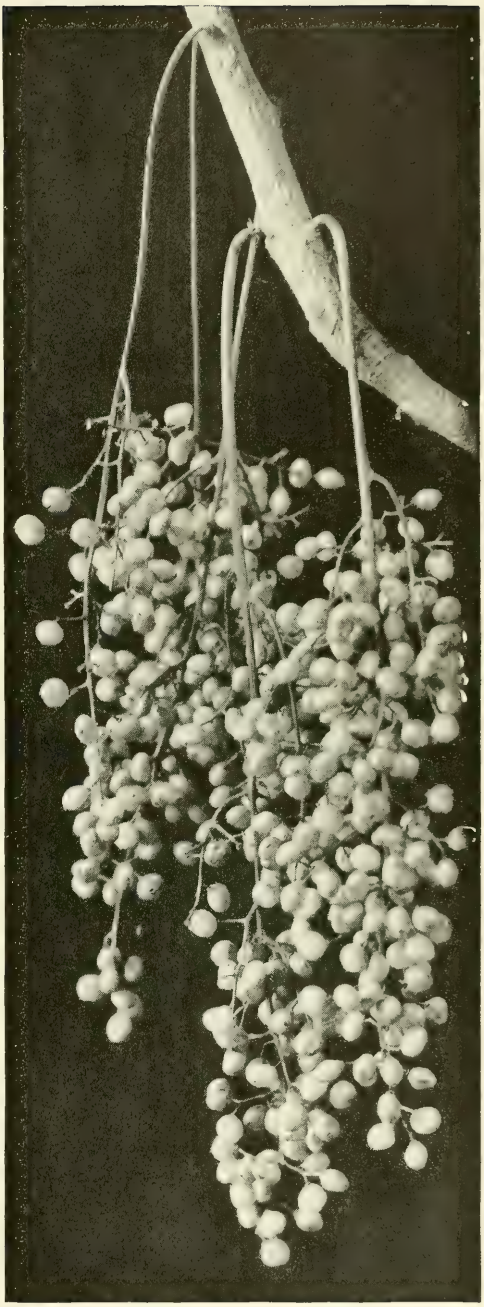
A SPECTACLE OF ENCHANTMENT

Apart from the phenomena of the snow, there occurs at rare intervals during the winter what Thoreau speaks of as a "frozen mist," when the trees and all other outdoor objects are covered in the early morning with a delicate hoar frost. This, of course, soon melts under the rays of the sun; but while it lingers the spectacle is one of enchantment.

"No snow has fallen, but, as it were, the vapor has been caught by the trees like a cobweb. The trees are bright, hoary forms, the ghosts of trees. Closely examined or at a distance, it is just like the sheaf-like forms of vegetation and the diverging crystals on the window-panes. You look up and behold the hugest pine, as tall as a steeple, all frosted over. Nature has now gone into her winter palace."

Akin to this phenomenon are the crystallized "rosettes," as Thoreau calls them, which are found sprinkling the surface of the ice after a night of severe cold. "They look like a loose web of small white feathers springing from a tuft of down, as if a feather bed had been shaken over the ice. They are, on a close examination, surprisingly perfect leaves, like ferns."

Frequently accompanying these feathery crystals, which are "so thin and fragile that they melt under your breath while looking closely at them," there is another form of needle-shaped crystals in bun-



POISON-DOGWOOD BERRIES: MASSACHUSETTS

Thoreau has numerous references in his winter notes to the novelty and beauty of the fruit of the poison-dogwood, which hangs in clustered panicles from the leafless stems of the shrub.

FOX TRACKS IN THE SNOW: MASSACHUSETTS

Thoreau took keen delight in reading the story of wild life in the woods as shown by the tracks in the snow, especially those of the fox. The foreground of the picture shows where the fox was digging for mice.

dles, or "as if oats had been spilled, like fibers of asbestos rolled." Both forms, he thinks, result from vapor congealing as it finds its way through interstices in the ice, and both are uniquely beautiful.

THE ICE-STORM

Rarest and most beautiful of all, however, are the phenomena attendant upon an "ice-storm"—something which does not occur every winter. In fact, it was only after several years of patient waiting that the writer was able to secure photographs illustrating this striking event.

The necessary conditions are: a gently falling rain, a stratum of air next the earth with temperature below the freezing point, and this overlaid with warmer strata from which the rain proceeds. Thus the rain freezes as fast as it falls, and there is gradually built up around every object a coating of ice. Then, when the sun comes out, the whole world is turned into a veritable crystal palace.

TRACKS OF A HARE

"Did this great snow come to reveal the track merely of some timorous hare, or of the Great Hare, whose track no hunter has seen?"

"All objects, even the apple trees and the rails, are to the eye polished silver. It is a perfect land of fairy.

"Seen at the right angle, each ice-encrusted stubble shines like a prism with some color of the rainbow—intense blue, or violet, and red.

"What a crash of jewels, as you walk!

"The fine spray of a myriad of bushes on the edge of the bank sparkles like silver.

"The drooping birches along the edges of the woods are the most feathery, fairy-like ostrich plumes of the trees. The pines are as white as a counterpane, with raised embroidery and white tassels and fringes. Each fascicle of leaves or needles is held apart by an icy club surmounted by a little snowy or icy ball. Finer than the Saxon arch is this path running under the pines, roofed, not with crossing boughs, but drooping ice-covered twigs in irregular confusion.

"God exhibits himself to the walker in a frosted bush today, as much as in a burning one to Moses of old."

Thus, for page after page, Thoreau attempts to convey some idea of the beauty of this icy wonderland. But no words

A FROSTY MORNING: MASSACHUSETTS

Occasionally during the winter there occurs what Thoreau speaks of as a "frozen mist," when the trees and all other outdoor objects are covered in the early morning with a delicate hoar-frost.

THE SNOW RECORD

From left to right: 1. Tracks of a pheasant retreating hastily. 2. The same pheasant approaching cautiously from cover. 3. Tracks of a rabbit, also probably alarmed. 4. Tracks of a partridge. Tracks of a fox coursing along the edge of the swamp are also discernible.

and no photograph can do more than merely hint at the reality. Whoever has once witnessed the phenomenon of a New England ice-storm can never forget its ravishing beauty.

THE ORGAN-PIPES OF ICE

Another icy spectacle which Thoreau always took pains to observe on its annual recurrence was the formation of icicle "organ-pipes" on the face of a certain cliff in Concord, and one can find the same process in operation, under suitable conditions, in exactly the same spot today. The water from melting snow trickles down over the perpendicular rock-face, and "its constant drip at night builds great organ-pipes of a ringed structure, which run together, buttressing the rock.

"Behind these perpendicular pipes, or congregated pillars, or colonnades run together are formed the prettiest little aisles or triangular alcoves with lichen-clad sides. The shadow of the water flowing or pulsating behind this transparent icy crust or these stalactites in the sun imparts a semblance of life to the whole."

This suggestion of life, by the way, was always a most welcome feature of Thoreau's winter walks. Any reminder of the past summer, such as a bird's nest with its "snowy egg," or the persistent panicles of poison-dogwood berries, "beautiful as Satan," or the scarlet fruit of the black alder, gave him keen pleasure.

Likewise the least promise of the coming spring, like the opening of the river channel, or the breaking up of the ice in the ponds, or a distant bluebird's warble. Even so simple a thing as a running brook called forth his enthusiasm. "Perhaps what most moves us in winter," he wrote, "is some reminiscence of far-off summer. How we leap by the side of the open brooks! What beauty in the running brooks! What life! What society! The cold is merely superficial; it is summer still at the core, far, far within."

INTERPRETING THE "GRAND OLD POEM WINTER" EVERYWHERE

Thoreau made all his observations of winter phenomena in Concord, but it by no means follows that one need make a

A BIRD'S NEST WITH ITS "SNOWY EGG"

During his winter walks Thoreau always took keen delight in discovering any reminder of the past summer, even if it was only a deserted bird's nest filled with snow.

journey to Concord to witness and enjoy the same phenomena. All through the northern portion of the United States, except upon the Pacific coast, there is annually staged upon the platform of winter the same drama of wonder and beauty which so aroused his admiration.

Indeed, in certain sections there sometimes occur spectacular effects of which Thoreau never witnessed anything more than the merest suggestion, such as the brilliant "sun-dogs," "inverted rainbows," and kindred atmospheric phenomena which frequently accompany days of intense cold in Minnesota and North Dakota. Also, in connection with many of the higher waterfalls of the northern States, there are superb displays of frost magic, such as that which annually draws a throng of visitors to Niagara, far transcending in magnitude and beauty anything which Thoreau ever saw on his winter visits to the tiny waterfalls of Concord.

But the ordinary aspects of winter, so familiar to all who dwell in regions periodically visited by the Ice King, Thoreau has made the subject of graphic description. The snow crystals falling upon his coat sleeve, the icy fretwork on the puddle by the roadside, the "booming" of the pond on cold evenings, the snow-encased pump, the farmer piloting his ox-sled through the drifts, the lisping of chickadees among the snow-laden hemlocks, the fisherman with his string of pickerel caught through the ice, the close-wrapped buds of trees and shrubs, the humming of the telegraph "harp," the snow-buntings and tree-sparrows—"true spirits of the snowstorm," the red alder catkins "switching in the face of winter and bragging for all creation," the woodchopper and his noonday lunch, the scream of the blue-jay—"a sort of wintry trumpet," the snow-fleas in the wheel-ruts, the frost-tracery on the window pane—all these and many other incidents and phenomena of the winter are faithfully and lovingly recorded.

Trivial matters? Yes, and yet they are so charmingly treated in Thoreau's interpretation of "that grand old poem called winter" that we forget their trivial and commonplace character and are made to see how much they contribute toward the beauty and the harmony of the whole.

NEW PICTURES PAINTED AT EACH SUNSET

There is one very common phenomenon of the winter time—a daily occurrence, in fact—which Thoreau dwells upon with marked frequency and always in a mood of special exaltation. To him, in all seasons of the year, the holiest hour of the day was the hour of the setting sun, and in the winter season its appeal was most potent.

Under date of January 7, 1852, he wrote: "I go forth each afternoon and look into the west a quarter of an hour before sunset, with fresh curiosity, to see what new picture will be painted there, what new panorama exhibited, what new dissolving views. Can Washington Street or Broadway show anything as good? Every day a new picture is painted and framed, held up for half an hour, in such lights as the Great Artist chooses, and then withdrawn, and the curtain falls."

WHERE THE WORLD GETS ITS OIL

But Where Will Our Children Get It When American Wells Cease to Flow?

By George Otis Smith

Director United States Geological Survey

IN THE course of the centuries the raw-material issue changes. In the long-bow epoch of England's military strength the conservationist feared a depletion of the yew wood which might give the Teuton, backed up by his larger forests, an obvious advantage in light ordnance. Later, when Great Britain's naval power depended upon her wooden ships of war, the anxious naval chief foresaw a possible shortage of the oak which made the walls that stood between England and her enemies.

The yew and the oak are no longer essential to national defense, for steel has proved the substitute in both arms and armor plate. Yet today those who plan for the future prosperity of their nation realize the extent to which other raw materials are essential to the general well-being, and for some of these we can see no adequate substitutes.

Foremost among these most useful and least abundant, if not, indeed, irreplaceable, commodities stands mineral oil, or petroleum, and not only the conservative Briton, but the most optimistic American, may well ask himself, Where will my children and children's children get the oil that they may need in ever-increasing amounts?

THE WORLD'S GREATEST OIL PRODUCER AND CONSUMER

The leadership of the United States as an oil producer and consumer is spectacular enough to satisfy our American love of doing things on a big scale. For sixty years, except in 1898 to 1901, when Russia reached the peak of its past petroleum production, the United States has led the rest of the world with its steadily increasing flow of oil.

But while we have contributed far more than half (61 per cent) of the oil that the world has used in all these years, we have already reached the point where we are consuming more oil than we produce. Is this position of the world's greatest user of petroleum as safe as it is spectacular?

The story of the petroleum industry in the United States extends back only sixty years. On August 28, 1859, oil was struck in the Drake well, near Titusville, in northwestern Pennsylvania, and when the pumping began the oil flowed in a tiny stream of 40, and later only 15, barrels a day; but since that day of small things the tide of oil has mounted higher and higher: 5 million barrels were produced in 1870, 26 million in 1880, 45 million in 1890, 63 million in 1900, 209 million in 1910, and 356 million barrels in 1918, with the output last year perhaps 20, or even 30, million barrels in excess of that record. The crest of this flood of oil must surely soon be reached.

A NIAGARA OF OIL

We are the world's greatest consumers of petroleum; but, impressive as are the 1918 figures of consumption — 413,077,113 barrels—no mind can easily grasp the idea of that quantity. Truly it is a flood of oil; for, if spread over the 60 square miles of the District of Columbia, these 413 million barrels would cover the area to a depth of nearly a foot and a half.

Or perhaps the eye can better visualize the torrent of oil that flows each year from the 203,400 wells, is pumped through the long pipe lines, and is brought up from Mexico in huge tankers, if we figure that a year's supply of oil equals the flow of the waters from the Great Lakes and their vast drainage basin over Niagara Falls for three hours and four minutes; or, in terms of the

Photograph from Dr. D. T. Day

THE SITE OF AMERICA'S PIONEER OIL WELL

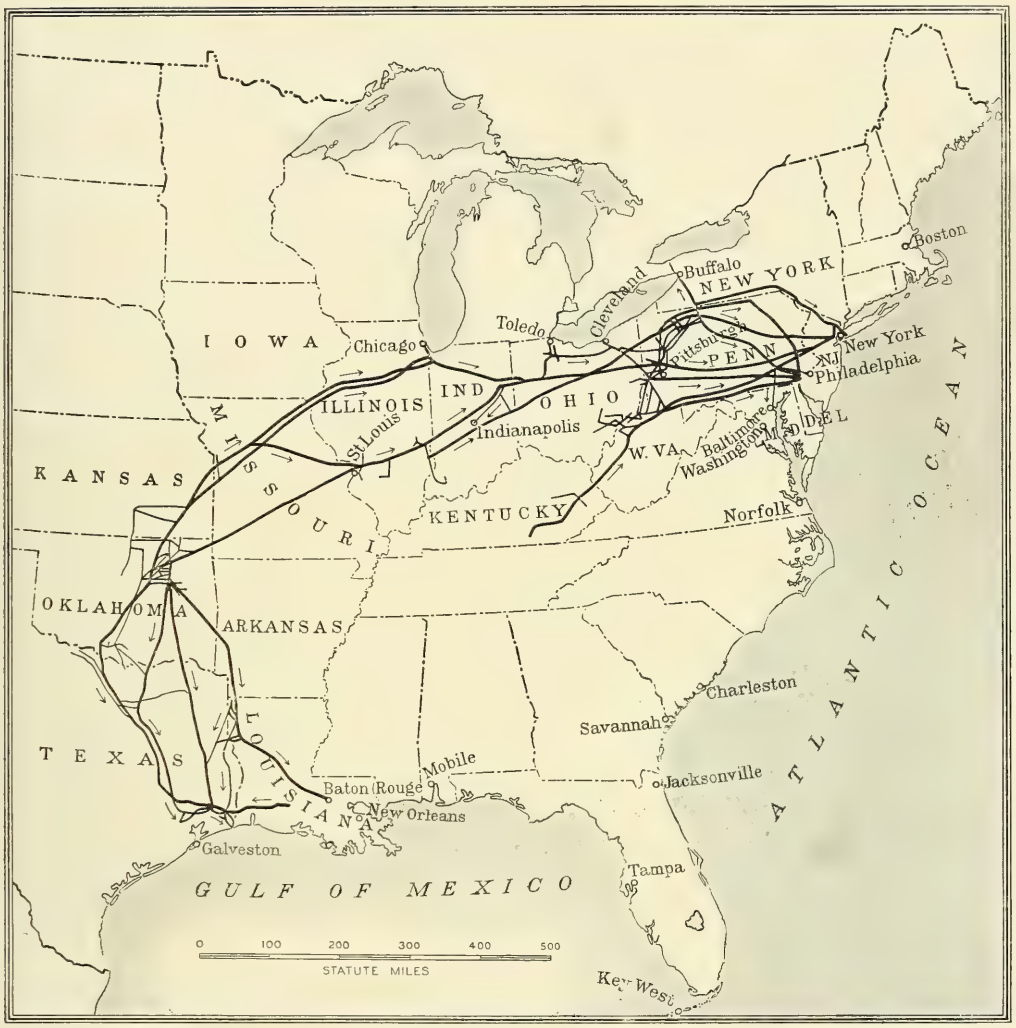
A new chapter in industrial history began sixty years ago with the flow of petroleum from this 69-foot bore-hole on Oil Creek, Pennsylvania. Edwin L. Drake did not strike it rich, receiving only an annuity from the Keystone State and a monument from the industry he founded.

smaller stream flowing past the Nation's Capital, if the Potomac at Great Falls were a river of crude oil, the nation's annual requirements could be met only with the flow at the summer rate for nearly four days and a half.

So it is that while in 1918 our "home fires" in power plant, blast furnace, locomotive, and residence consumed a mountain of coal a mile and a third in diameter and nearly 2,000 feet high, we also used a river of oil.

Credit is often due to the silent partner in a business, and the marvelous growth of our oil industry owes much to its own transportation system, unseen and unknown by most citizens, yet far more efficient than the railroad lines of which we are so proud.

Beginning with four miles of iron pipe



A SKETCH MAP SHOWING THE ELABORATE OIL PIPE-LINE SYSTEM WHICH FORMS A NETWORK BENEATH THE SURFACE OF THE EASTERN HALF OF THE UNITED STATES

There are enough oil pipe lines in the United States to girdle the earth at the equator and have 5,000 miles to spare.

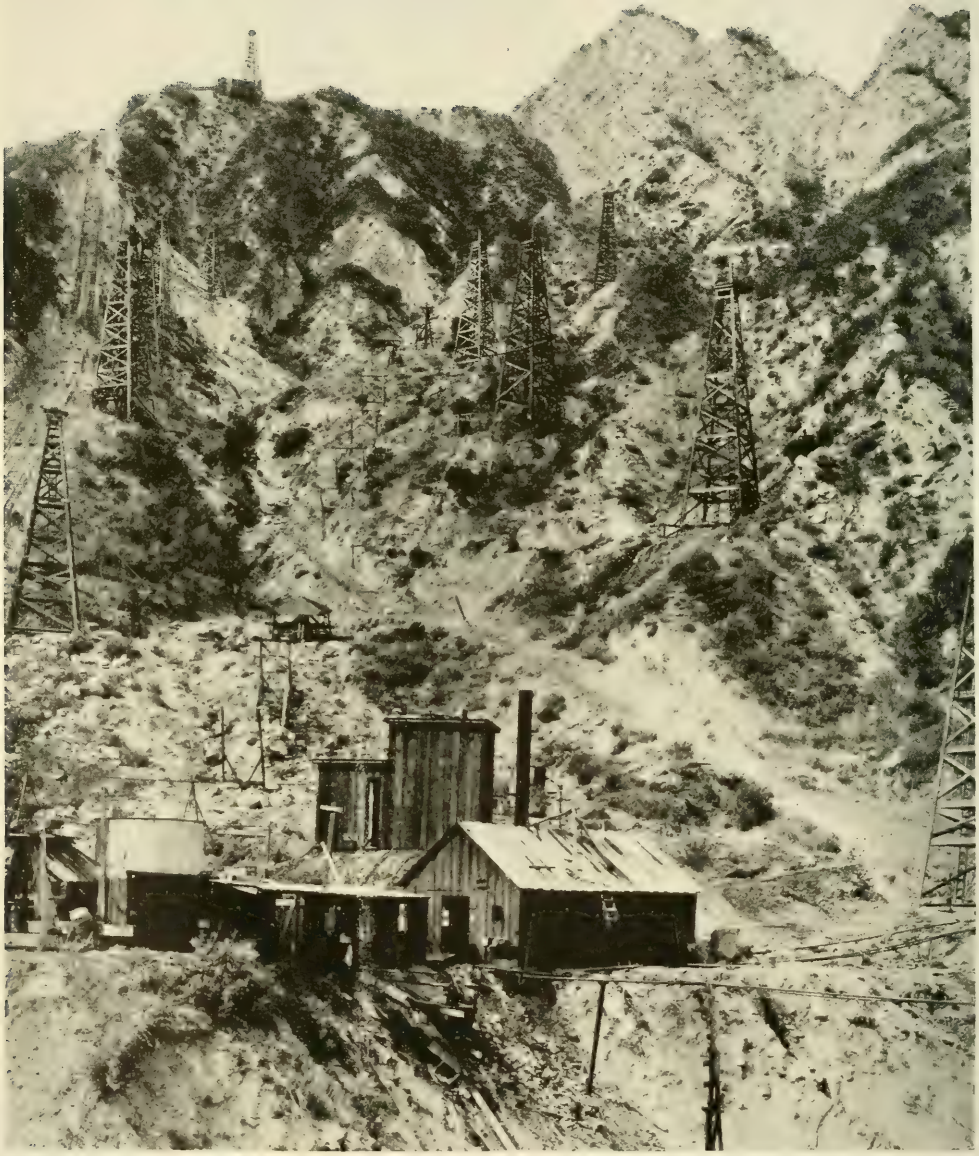
laid down in western Pennsylvania at the close of the Civil War, this system now embraces a huge network of buried pipes from four to eight inches in diameter, trunk lines and laterals, aggregating nearly 30,000 miles (see map above).

A VAST NETWORK OF OIL PIPE LINES

Along these hidden transportation lines there are pumping stations every 40 miles or so, but the daily circulation of oil in these long arteries is appreciated only by the oil operators who sell their product at one end and the refiners or shippers who receive it at the other end.

Another measure of this pipe-line system is given in the fact that it would take approximately two days' flow from the 200,000 wells of the country simply to fill these pipes.

Petroleum's rank among the minerals is won not by attractive appearance, but by sheer usefulness. Few of us fully appreciate how essential this mineral oil is in



Photograph from U. S. Geological Survey

OIL WELLS IN VENTURA COUNTY, CALIFORNIA

The topography and the locality suggest "nothing venture, nothing have," which is one of the rules in hunting oil.

Photograph from U. S. Geological Survey

NUMBER FOUR WELL AT JOY FARM, OHIO, DRILLED IN 1864 AND STILL PRODUCING OIL

the world economy or realize all the changes that have come about in its use within a decade or two.

OIL NO LONGER OUR LIGHT BY NIGHT, BUT PREMIER POWER SOURCE

When most of us were in school, "oil" meant kerosene, and gasoline or benzine was something to be bought in a bottle at the drug-store or the paint shop. In those earlier days the oil refiner put as much gasoline in his kerosene product as the traffic would allow; today the automobilist complains that his gasoline contains too much kerosene. The refiner simply robs his less marketable kerosene of the more inflammable content; so that, as has been suggested, if Widow O'Leary's cow again kicked over the lamp, in all probability the spilt oil would not set Chicago or any other city on fire.

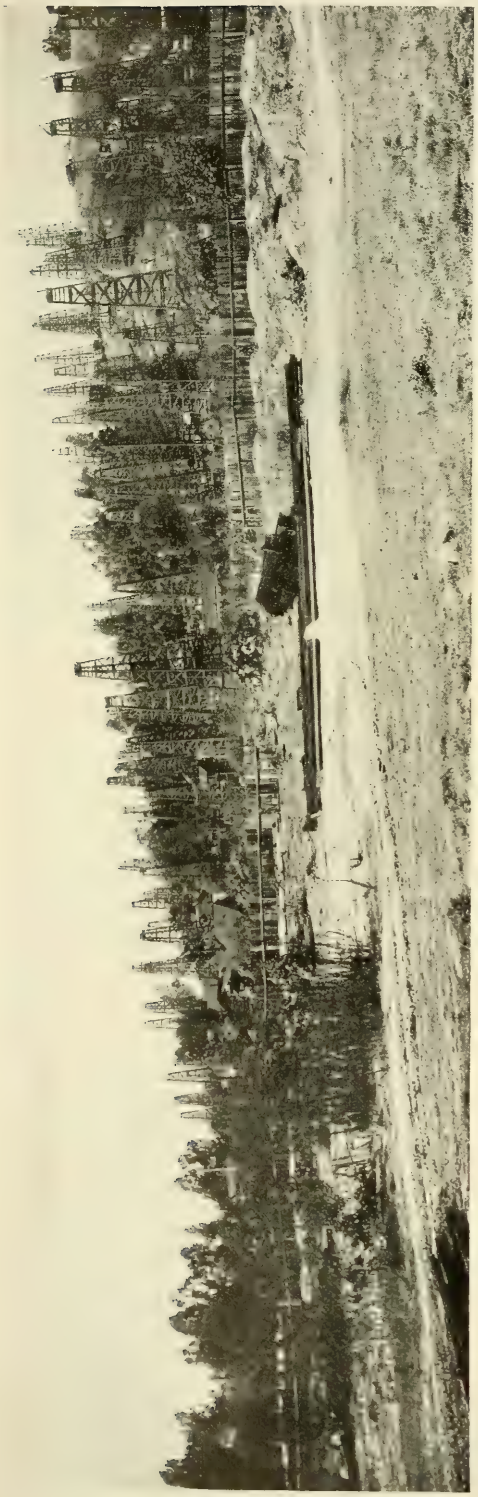
In those earlier days, too, fuel oil played no part in industry. Then, petroleum's future mission seemed to be to light up the dark corners of the world—to be the handmaiden of Minerva; today, oil has become the premier motive power, not only on land and sea, but even in the heavens above and the depths below—truly the best servant of Mars and Mercury.

Marshal Foch is quoted as saying that "a drop of gasoline was worth in war a drop of blood," and M. Bérenger, the French Commissioner-General of Petroleum, expressed the same idea when he called attention to the fact that victory on the battlefields of Belgium, France, and Italy "could not have been gained without that other blood of the earth which is called oil."

"And if petroleum has been the life blood of the war, it will be still more *the life-blood of peace.*" The strategy of peace should, however, lead us so to plan for wise use of this precious fluid that Mother Earth will not too soon be "bled white."

MORE THAN 300 PRODUCTS OF PETROLEUM

The number and variety of uses of petroleum and its products are continually increasing, but even more striking is our increased dependence upon a few of the products of the oil refinery, notably gaso-



Photograph from U. S. Geological Survey

A GLIMPSE OF A SOUTHERN CALIFORNIA OIL FIELD

A forest of derricks, where many wells did the work of a few, thus illustrating the waste of capital and labor under conditions of competitive drilling.

line, kerosene, the many types of lubricating oils, and fuel oil.

There are said to be 300 or more products of petroleum, each with its own use. Some of these products serve merely our convenience, such as the artificial "vanilla" flavoring or the cover of paraffine on the jar of jelly or marmalade; others were found during the war period to be absolutely essential to industry on a large scale—for example, the heavy oil used in tempering steel plates.

One picture of the demand for the principal petroleum products can be seen in a recent statement of United States Army peacetime requirements, which included 74 million gallons of fuel oil, 11 million gallons of gasoline, two million gallons each of lubricating oil and grease, and one million gallons of kerosene. Not only will the size of this single order open some eyes, but its make-up is significant and disconcerting.

Taking the figures of the Bureau of Mines on refinery production last year, we find that the output of gasoline was not quite double that of kerosene, and the output of lubricants was less than half that of kerosene, and here the army wants eleven times as much gasoline as kerosene, and twice as much lubricating oil. The discord between demand and supply in this one order is even worse for fuel oil, of which the output last year was about five times that of kerosene; and yet the army wants 74 times as much.

LUBRICANTS ARE THE BAROMETER OF BUSINESS

Too broad an inference from any one set of figures is unwise, but other statistics point in the same direction: Fuel oil is used on 357 vessels of our navy, and the Shipping Board has an-

From "World Atlas of Commercial Geology," U. S. Geological Survey

MAP SHOWING PRODUCTION OF PETROLEUM IN THE UNITED STATES IN 1918, AND THE OUTLINES OF THE PETROLEUM AREAS

Each black dot represents one per cent of the total production of petroleum in the United States. The dotted lines surround oil-producing areas. Where the production is less than one per cent, the area is indicated by the cross.

nounced that there will soon be 1,731 oil-burning vessels of the merchant marine under the American flag; gasoline is now sold at every cross-roads, and we know that the use of this fuel in automotive engines has more than quadrupled during the present decade; and the country's demand for lubricating oil, which is an essential in every phase of modern civilization, increases so rapidly that we must agree with the Bureau of Mines in the belief that the current consumption of lubricants is an excellent barometer of business and industrial conditions.

SIX MILLION PLEASURE CARS IN THE UNITED STATES

Inventive genius and economic necessity may from time to time change the relative demands for this or that petroleum derivative, but the sum total of these demands must increase as the number of swiftly turning wheels in the world increases.

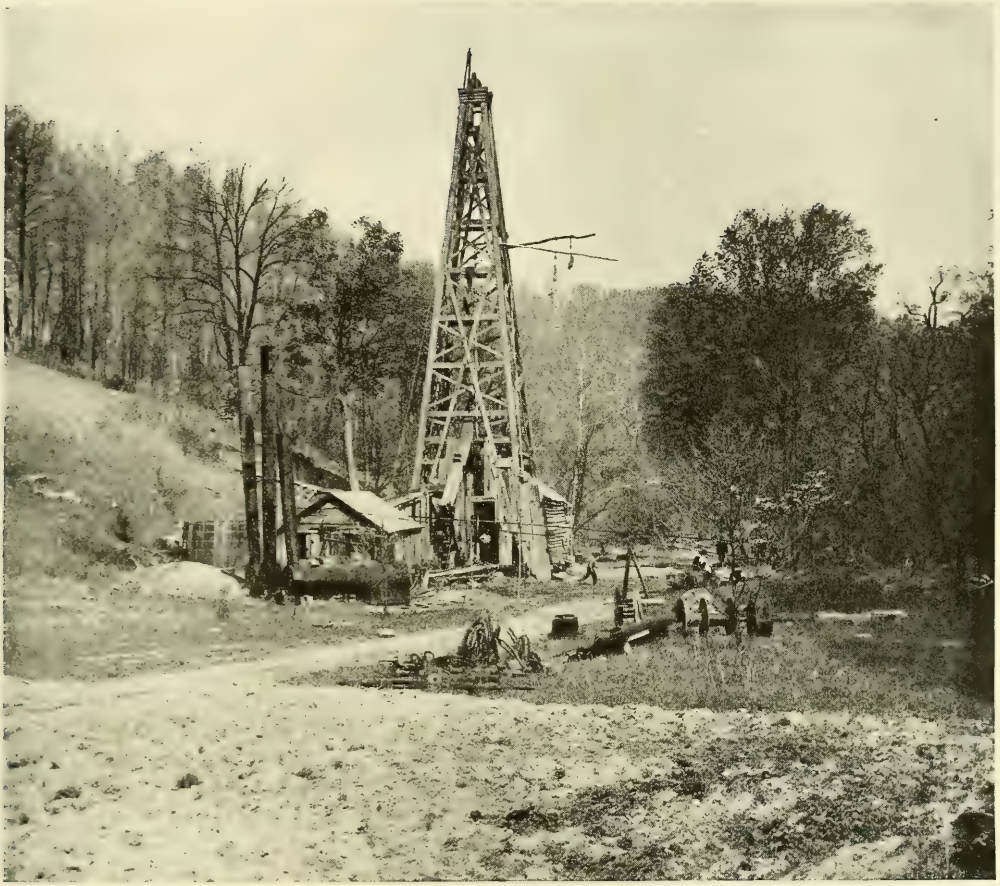
It is when we think of the marvelous growth of the automotive industry that we realize a future demand for lubrication that staggers even the prophetic statistician. With more than six million pleasure automobiles operated in the United States alone, we have an annual consumption estimated, by the officials of the foremost company manufacturing high-grade lubricants, at 120 million gallons of lubricating oil, where twenty years ago the demand for this purpose was practically nothing.

Moreover, today a fleet of half a million motor trucks travel up and down our city streets and State roads, delivering every kind of commodity from eggs to pianos, and these powerful motors furnish a market for 37½ million gallons of lubricating oil. But while we may expect the demand for oil by automobiles to continue to increase rapidly and the requirement by trucks may possibly double within a few years—indeed, a tire company estimates that even now a million trucks are in service—who can even guess at the number of tractors that may be operating on our farms within

Photograph from U. S. Geological Survey

THE SUMMERLAND FIELD IN SANTA BARBARA COUNTY, CALIFORNIA

Where man's conquest of the subterranean treasure extends beyond the shore-line. These wells were drilled 300 feet below sea-level to reach the oil.



Photograph from Hope Natural Gas Company

THE DEEPEST HOLE IN THE WORLD

America leads in courage and skill in exploring the earth's crust in the search for oil and gas. The Lake No. 1 well in West Virginia had reached a depth of 7,589 feet, or 240 feet deeper than the deepest well in Europe, when the steel cable parted nearly three-fourths of a mile below the surface. This is the second world record established by the Hope Natural Gas Company, the Goff well being 7,386 feet deep, but neither of these West Virginia wells has yielded anything but facts for the geologist.

the next five years? Already the number of tractors in operation is estimated as a third of a million, and they consume about 35 million gallons of lubricating oil.

We have, then, a total of fully 200 million gallons of lubricating oil already required to keep the automotive equipment of our country running smoothly, and we must not shut our eyes to the fact that millions and millions of gallons more will be needed each year.

HOW OIL SAVES POWER

The steady growth of industrial America is observed by all, but we need the help of census statistics to realize the rate of that growth. The power used in our manufacturing has about doubled in the past sixteen years; the kilowatt-hours turned out by our public-utility stations have increased eight or nine fold in that same period. Indeed, the single State of New York will use far more electric power this year than the whole country did in 1902.

And so the demand for lubricants becomes stronger on the road, on the farm, and in the mill. Still, while we think of this rapid development of power as using increased amounts of oil, it is equally true that oil saves power; so that if ma-

Photograph from D. A. McDannald, Orange, Calif.

THE WONDER-WORKERS

Drillers whose skill taps the oil-sands half a mile or more beneath the surface.

chinery multiplies man-power, lubricating oil is a good and faithful servant that deserves more than a passing thought.

With all these demands for fuel and lubricants, who can venture an estimate of our needs even ten years hence? Whence will the petroleum come to meet these needs? That river of oil representing our 1918 consumption drew from the ground more than one-twentieth of the quantity estimated by the United States Geological Survey geologists as the content of our unrecovered underground reserve, and it also took nearly one-fifth of the oil stored above ground.

The estimate of about 6½ billion barrels as now available is far less impressive when we realize how fast we are using it up and that while we have burned and wasted less than 1 per cent of the coal resources of the United States in the last 100 years we have apparently used up 40 per cent of our available oil supply in only 60 years.

This is why the hunt for oil has become world-wide and suggests a compelling reason for Americans to lead in that hunt.

A HUNTER WHOSE WEAPON IS THE DRILL

The geologist has lately come into his own as a money-saver in the employ of oil companies. Today not less than 750 geologists are in the employ of corporations, large and small, selecting the most promising fields for oil exploration and sites for new oil wells. Where it costs from $8 to $20 a foot to drill a well and the oil sands are 3,000 to 4,500 feet beneath the surface, as in California; or 450 to 3,600 feet, as in Oklahoma; or possibly as much as 3,600 feet, as in the

Photograph from Mining Review, Los Angeles

THE LAKEVIEW "GUSHER" OF CALIFORNIA

In its day a record-breaker, but not comparable to the Mexican "gushers." The spectators on the sand-bag embankment later discovered their linen to be spotted with oil-mist.

new Ranger field in Texas, the expense attending the drilling of a single well is something to be considered in the economy of the business, especially when, as the Bureau of Mines states, oil wells, like everything else, cost about twice as much as they did before the war.

The geologist simply applies his science to the problem of making as many wells as possible successful and of preventing drilling where oil cannot be found. Every "dry hole" is, in the last analysis, a tax on the consumer, that patient Atlas of the world's ever-mounting load of high costs.

A recent study of the results of extensive geologic examinations on the Osage Indian lands shows conclusively that in this region, which rather favors the Government geologist in his effort to locate oil, his geology was right 87 per cent of the time, when tested by the drill. Business can ask of science no better percentage of success than that, and the money and labor and supplies that can thus be saved to the nation constitute no small item.

A BIG LEAK—THE STOCK PROMOTION GAME

One of the leaks in the nation's task of finding oil is nearer home to many of us. The stock-promotion game attracts too many dollars to no useful purpose.

It has been stated that two years ago these much-advertised oil companies, with more assets on paper than on the ground or under the ground, were to be credited with a very small fraction of 1 per cent of the oil yield of Oklahoma; indeed, the issue of stock certificates reached the point where for every $555 of ill-advised investment only one dollar's worth of oil was produced. Thus does the combination of unscrupulous stock-peddler and ignorant investor undo much that the conscientious oil-producer is striving to accomplish in getting the most oil out of the ground at lowest cost.

Photograph from Bureau of Mines

A "TANK" FARM

Where one of the group of huge storage tanks has been set on fire by lightning. In our automobiles we also use the electric spark for ignition, but to better purpose.

Conservation touches petroleum at many points. There is need for a country-wide thrift campaign looking to the saving of this essential resource. Manpower and oil ought to be conserved at all stages of production and consumption by better methods in the discovery, drilling, recovery, transportation, refining, and use of petroleum and its products.

The price of crude oil has just reached a new level, and eventually this must influence the price of the refinery products, a fact that ought to give impetus to thrift among users of every petroleum product.

WHERE THE WASTE BEGINS

Unwarranted optimism, which seems indigenous in most parts of the United States, has led both the oil industry and the public to waste this best of fuels. The program of wastage begins below the ground with only partial recovery, goes on above the ground with leakage and evaporation, and continues all along the line to the indiscriminate burning of fuel oil under boilers with regard for convenience rather than for efficiency, or to the even less defensible use of petroleum for oiling our roads.

In oil-field operation, in refinery practice, and in the use of oil everywhere, too often the dollar test of economy is the only one applied. The situation, however, is critical enough to demand another rule—that of taking thought of the morrow and of weighing the questions of ultimate supply and demand.

But, with those early forest conservationists of old England in mind, the question may be asked, Are there no practical substitutes or other adequate sources? The obvious answer is in terms of present prices; the real answer is in terms of cost in man-power.

THE ADVANTAGES OF OIL OVER COAL

Whether on land or sea, fuel oil is preferred to coal because it requires less

© Underwood & Underwood

WORKING NEAR THE FIRING-LINE

The lineman repairing wires close to the huge oil tank, which the firemen are trying to keep below the explosion temperature. This $2,000,000 fire on Long Island caused the greatest call for fire apparatus that New York City has ever known.

bunker space and fewer firemen; and, back of that, in the man-power required in its mining, preparation, and transportation, the advantage on the side of oil is even greater. So, too, the substitute for gasoline in internal-combustion engines, whether alcohol or benzol, means higher cost and larger expenditure of labor in its production. Moreover, for alcohol agricultural land would be required, and for benzol in the quantities needed a far greater coal consumption than is now necessary.

Again, while we fortunately have our great reserve of oil shales as an independent source at some future date, we do well to consider the practical contingency suggested by Mr. Requa, that to develop this source on a scale comparable in output with our present oil supply "would require an industrial organization greater than our entire coal mining organization." Plainly, our country can not afford to support another such army of workers until we reach another stage in our industrial development.

The question of safeguarding America's oil supply has been prominently before the American people for more than ten years. In September, 1909, President

Photograph from Bureau of Mines

AN OIL TANK SET ON FIRE BY LIGHTNING

A pillar of smoke by day that represents a total loss to the world that needs oil.

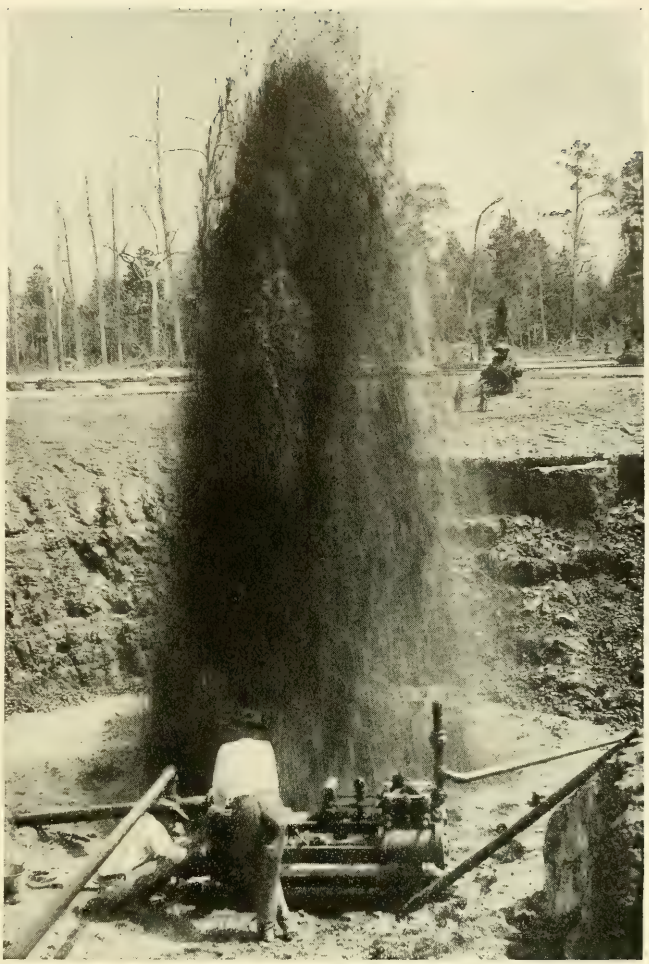
Taft ordered that all public lands believed to contain petroleum should be reserved from disposition until a law could be passed that might assure an adequate supply of fuel oil and lubricating oil for our navy and in some degree check the wasteful overproduction in the rich oil fields of California. Such a law is now under consideration by the conference committee of the two Houses of Congress.

WHERE WE SHALL GET OUR OIL IN FUTURE

Ten years is a long period for these "temporary" withdrawals to run pending the enactment of suitable legislation, and in that time the country's need of oil, as measured by its consumption, has doubled. If in 1909 our Chief Executive had reason to plan the safe and sane disposal of the petroleum still in public ownership, in 1920 we surely need to look even further and see if possible where our children will get the oil they will require in increased amount.

On the accompanying map of the world (see page 200), are indicated the regions from which, according to present information, the oil supplies of the future are to be drawn.

The diagrammatic representation of the relative abundance of the oil resources in the ground in different countries is at best highly speculative. Most of the other countries outside of Europe have not been covered so thoroughly by geologic examinations as the United States. In fact, some of the oldest and most highly civilized countries have not been studied by geologists specially trained in the geology of oil and gas, as is shown by the fact that it remained for an American expert to bring to the attention of the British the probabilities of the occurrence of oil fields in old England itself.



Photograph from M. L. Alexander

ENGINEERING EXPERTS BRINGING UNDER CONTROL A "WILD WELL" IN LOUISIANA

A glance at the map shows that outside of the United States the great oil supplies of the future, so far as now known, are centralized mainly in the Near East, in South America, and in Mexico. According to reports, there may be great reserves of oil in Africa, and it is also possible that eventually considerable supplies may be discovered in the Far East.

In general, the regions developed first and drawn on most heavily are, of course, likely to be soonest exhausted. Therefore it is practically certain that, as the oil resources of the United States and Rumania diminish and the reserves of Mexico also yield under the pressure of rapidly increasing exploitation, the world

Photograph from Mexican Petroleum Co.

THE WORLD'S GREATEST OIL WELL

A well in Mexico named Cerro Azul No. 4 shot a column of oil higher than our Washington Monument and drenched the country with a rain of oil for two miles around. Engineer measurements showed the column to be 600 feet high and the flow to have been more than a million barrels in the week before man harnessed this great force.

will have to look for its oil supplies to those regions where inaccessibilities and lack of demand, due to the social and industrial backwardness of the peoples, have hitherto retarded exploration and production.

HOW MEXICO'S OIL HAS BEEN EXPLOITED

The rapidity with which a region of relatively recent development may be exploited is illustrated in Mexico, whose petroleum output has risen since 1910 until it is second only to the United States, having doubled in the last five years. Mexico has been a land of oil-gushers and big wells, and with less than 300 producing wells the potential daily production has been estimated as about one and a half million barrels, but the actual output is not much more than 10 per cent of that.

The increases in production in the United States and Mexico for the year 1918, as compared with 1917, are respectively twenty million and eight million barrels. This shows how large a responsibility for the world's oil supply Mexico is already assuming.

Photograph from Mexican Petroleum Co.

THE CERRO AZUL NO. 4 IN FULL FORCE

The great volume of gas and oil completely wrecked the derrick, and in the first blast of gas threw the 2-ton drill-bit high in the air, landing 125 feet from the well and within three yards of a "movie" photographer. Photographing a wild well is not without discomfort and danger.

What is to happen when, following the United States, Mexico must reduce her output with the progressive exhaustion of her oil resources, and what are to be the competitive conditions in the United States when the other great nations of the world, whose use of petroleum is now relatively insignificant, awaken to the realization of the unique and almost priceless advantages of this great natural resource?

The United States, though the largest producer and consumer of oil, has given too little heed to the future; Great Britain, almost the smallest producer, has been the first to foresee petroleum's "transcendental importance to the world's industrial future," and, following up vision with action, has been the most active in providing for that future.

BRITAIN'S METHOD OF CONTROLLING OIL SUPPLIES

Sidney Brooks's phrase, "commercial statesmanship," may be the transatlantic term for "dollar diplomacy," but it aptly describes the British method of seeking

TAMING A GUSHER

The big Mexican well, despite its great earth forces, was brought under control. A closer view of Cerro Azul No. 4 after the wrecked derrick was cleared away and heavy clamps, five feet long, fitted over the top of the well-casing (see successive steps in mastering the well, pages 196, 197, and 199).

THE HALTER HALF ON

The heavy valve is partly on and is spraying part of the oil hundreds of feet on one side. Any one who has screwed a nozzle on a garden hose understands the process in miniature, but this oil-hose was running at the rate of three barrels a second (also see illustrations on pages 196, 197, and 199).

Photographs from Mexican Petroleum Co.

Photograph from Mexican Petroleum Co.

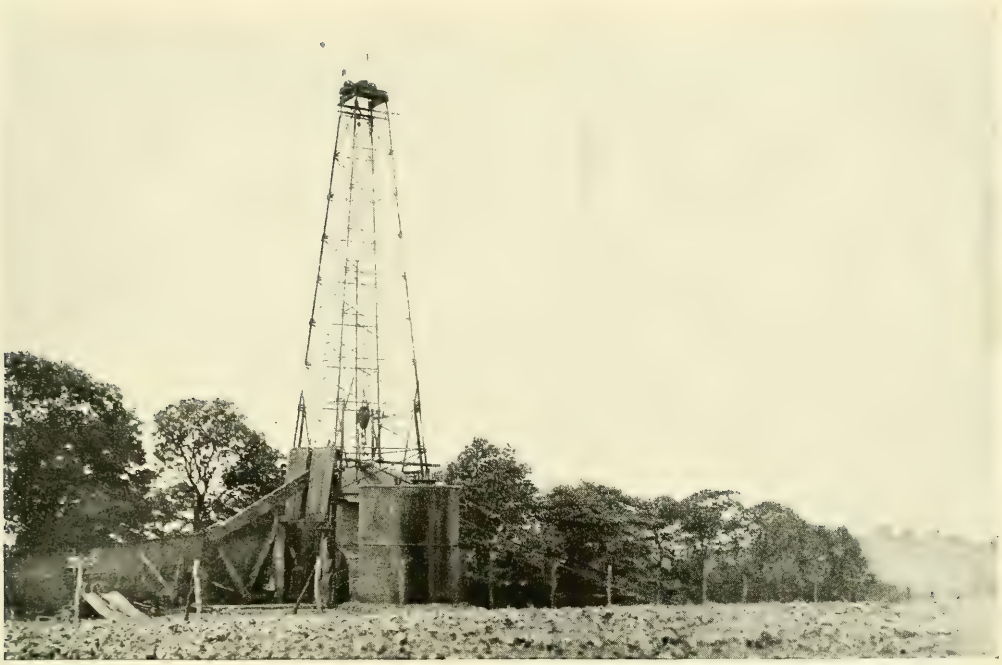
THE VICTORY WON: THE WORLD'S PREMIER OIL GUSHER HARNESSED

The successful issue of a week's campaign, for which there had been months of preparation. The valve is in position and ready to close. All of the flow now passes through the pipe, and the great reservoir of oil, 1,752 feet below the surface, is thus connected up with the 8-inch pipe lines running down to Tampico, where tankers load to supply the oil-hungry world (see other photographs of the Cerro Azul well on pages 196, 197, and 198, constituting a pictorial history of the great Mexican gusher).

From the U. S. Geological Survey

KNOWN AND POSSIBLE OIL RESOURCES OF THE WORLD

A diagrammatic index showing distribution and relative size of oil supplies for the future, as estimated according to present information (see page 195).



Photograph from Arthur C. Veatch

ENGLAND'S DISCOVERY WELL

Located in Derbyshire by an American geologist, drilled by American engineers and skilled workmen, with American machinery and well supplies, this all-American well struck oil in England almost exactly 60 years after Drake discovered oil in Pennsylvania.

control of an oil supply adequate for the nation's needs. John D. Northrop, in a review of the political and commercial control of the petroleum resources of the world, thus sums up the British position:

"The strength of Great Britain's present position in the world's petroleum affairs lies in a strong governmental policy in the matter and in the wide scope of British petroleum investments, embracing practically every country of which petroleum is an important product and nearly every country of which it is a product of potential importance."

Not only do the British oil companies rejoice in such suggestive names as "British Controlled Oilfields," but at the stockholders' meetings the policy is stated in plain language as providing the safeguard of a voting trust so that no financial control "can divert even a single barrel of oil from national or imperial requirements."

It is easy to see that Great Britain's world-trade policy has given oil this "imperial" recognition; and when we picture the return of the American flag to the seven seas, we too must plan for an oil supply available wherever needed. Any nation which today aspires to a large part in world commerce imposes upon itself an oil problem, for the future freedom of both the sea and the air will be defined in terms of oil supply.

AMERICAN SHIPS AND THEIR APPETITE FOR OIL

The new demand of our shipping program alone involves fuel oil in quantities equivalent to nearly one-half of the present domestic output, and, unless there is some corresponding decrease in other demands, this new requirement must be met with an increase in production of crude oil of nearly 200 million barrels.

The United States shipping program further calls for a chain of oil stations encircling the globe. The Shipping Board has already announced that the first steps have been taken to establish fuel stations along the trade lanes as well as at the world's cross-roads, and thus to assure unrestricted operation of our ships in the world's trade.

But economy on a large scale will mean that not only must the oil supply be put where it is needed, but the oil must come, if possible, from near-by sources. American tankers encircling the world with cargoes of Texas or California oil appeal to the imagination, but involve too high a transportation cost; better, some control of oil supply on other continents.

America's experience on the world scale has been gained as an oil merchant more than as an oil-producer. The illumination of the Orient with American kerosene has been followed by the lubrication of the whole world with special oils from American refineries; and now we hear of a garage in Guatemala 7,000 feet above the sea, or another in far-off Australia using American gasoline and lubricants exclusively.

This commercial campaign has been a worthy one, especially in its far-seeing outlook; but do we look far enough? We have been draining our own oil pools in part to supply the needs of the rest of the world, but we have made little effort to render the rest of the world self-supporting in oil production. Whether such a national policy is to be characterized as that of a spendthrift or that of an altruist, it is certainly too short-sighted.

NEED FOR OIL PIONEERS

The facts of the present situation call for some new pioneering by the United States. This appeal to American brains and American dollars is made for the patriotic purpose of providing for the future well-being of our own country. Already American geologists have helped to develop the oil resources of every continent, the latest contribution being that of A. C. Veatch, who as chief geologist for Lord Cowdray located the discovery well at Hardstoft, Derbyshire, England. This pioneer well struck oil at a depth of 3,078 feet, and since June has been flowing at the rate of 12 barrels of high-grade oil a day.

Central England has thus been shown to be of importance as a source of petroleum; and it is gratifying to note that American geologists, American engineers and drillers, American rigs, and American oil-well supplies thus all "did their bit" for Great Britain at the time when the submarine menace led Lord Cowdray to place his petroleum staff at the disposal of the nation.

This pioneering spirit should now lead American capital and American engineering to seek new sources of petroleum supplies in foreign fields for the benefit of the America of tomorrow. Nor can this be done without popular support, inspired by general appreciation of oil as our servant, a servant that works 24 hours a day and 7 days a week.

The "open-door" policy is best for America and the world; encourage American capital to enter foreign fields and protect foreign capital wherever invested in our country. However, the spirit of reciprocity does not require that the United States shall always keep its own door of opportunity open to the nationals of all nations, irrespective of their attitude to Americans in the other parts of the world.

The part our Government should take in planning to meet our future needs is to give moral support to every effort of American business to expand its circle of activity in oil production, so that it will be coextensive with the new field of American shipping.

This may mean world-wide exploration, development, and producing companies, financed by United States capital, guided by American engineering, and safeguarded in policy because protected by the United States Government.

Thus only can our general welfare be promoted and the future supply of oil be assured for the United States.

INDEX FOR JULY-DECEMBER, 1919, VOLUME READY

Index for Volume XXXVI (July-December, 1919) will be mailed to members upon request

VOL. XXXVII, No. 3 WASHINGTON MARCH, 1920

THE NATIONAL GEOGRAPHIC MAGAZINE

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MASSACHUSETTS—BEEHIVE OF BUSINESS

BY WILLIAM JOSEPH SHOWALTER

LILLIPUT in area, Brobdingnag in industry; forced to get its bread elsewhere, but helping to clothe nations; longest American, except Virginia, in the span of its history, yet least American, except Rhode Island and the Canada-bordering States of the Mississippi Valley, in the ancestral stock of its present inhabitants; losing half of its improved farm lands in thirty years, while doubling its population—Massachusetts rewards the investigator of its twentieth century status with many contrasts and not a few paradoxes.

Everybody knows that the Bay State is one of the smallest of the Commonwealths that compose the United States of America, but who realizes that it takes as many Massachusetts to make a United States as it takes days to make a leap year? Or who appreciates the fact that in area there are as many Bay States in California as there are holes in a full golf course.

A GIANT IN ALL SAVE SIZE

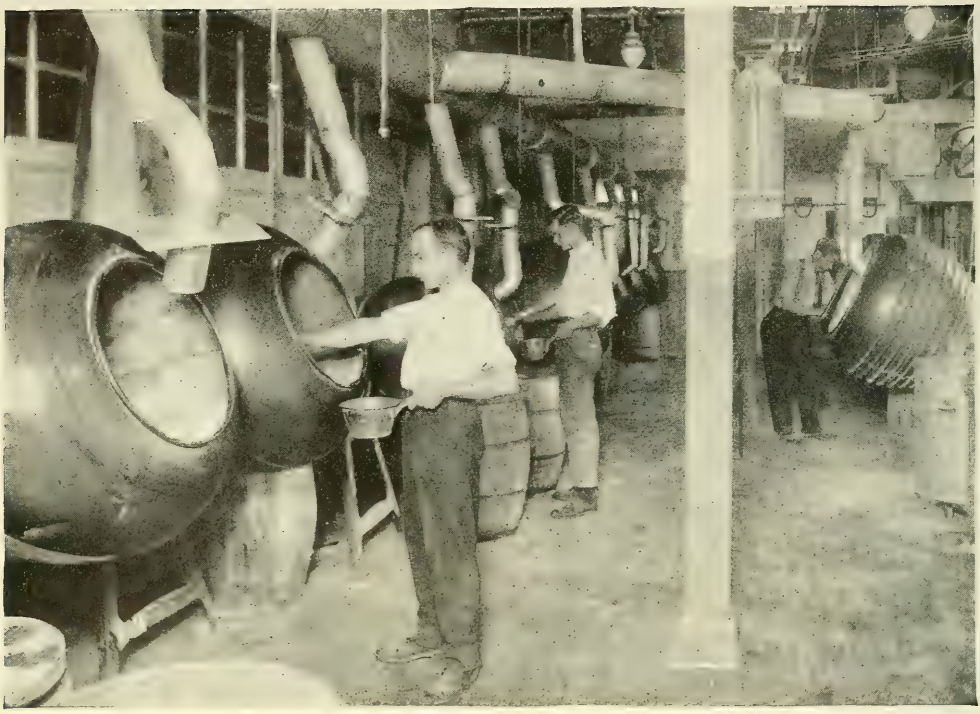
The crow needs to fly only 135 miles in going from Sheffield to Salisbury, or only 180 miles in winging its way from Greylock's summit to Chatham's sands, while the distance between Lake Monomonac, which spans the New Hampshire boundary, and Lake Chaugogagogmanchaugagogchaubunagungamaug, which touches Connecticut, is only a little longer than the name of the latter.

But this midget in domain is a giant in power. Measured by the products of its factories, by its financial contributions to the Federal Government, it occupies fifth place in the sisterhood; measured by the money it annually appropriates for its own betterment, it attains fourth place from the top, and is a lively disputant with Illinois for third; measured by the debt it has dared to incur in order to promote the welfare of its people, it takes second place, despite the fact that there are seven States that surpass it in wealth.

This year Plymouth, Massachusetts, plans to entertain the country in honor of the 300 years that will have passed since New England was born. There are citizens in the Bay State who have ten generations or more of American blood in their veins. Yet two-thirds of the people of the Commonwealth have sprung from parents one or both of whom were born under alien flags.

Where Paul Revere lived in Revolutionary times is now Little Italy, almost as foreign in the tongue spoken as Naples or Genoa. With only a third of the State's population born of parents who first saw the light in America, how small must be the percentage born of full colonial lineage!

But is Massachusetts less American for its tremendous foreign stock? Look at the recruiting records — holding sixth place in population, but fifth in voluntary enlistments for the World War. Look at the Liberty Loan records—third place in the first and second loans and fourth place in the other three.



Photograph by Leon H. Abdalian

THE PILL-COATING ROOM OF A MASSACHUSETTS DRUG COMPANY

As these huge containers revolve they sugar-coat pills at the rate of 12,000,000 in 24 hours.

Eight people out of nine in Fall River may have foreign blood in their veins, but Fall River never failed to go over the top with every drive. Seven out of eight of the inhabitants of Lawrence, where the paper for THE GEOGRAPHIC MAGAZINE is made (see also pages 234-238), may have grandparents born under alien flags, but in the Third Liberty Loan drive only six of the major cities of the United States showed a greater proportion of subscribers.

MANUFACTURES THRIVE AT THE EXPENSE OF AGRICULTURE

Manufacturing thrives in Massachusetts, but it does so at the expense of agriculture. No other State in the American Union has such a small proportion of its people engaged in the oldest of civilized vocations. Only one breadwinner in a score finds his food in farming, forestry, animal husbandry, and fishing.

What pathos there is in the thought that more than half of the ground the Pilgrim people for two centuries fought so hard to wrest from forest and stone should have been surrendered to weed and brush during the last three decades!

Motor out from Boston to Lexington, and thence by Bedford to Lowell. Did ever a hardy and spirited race leave a greater monument to its determination in combating inhospitable Nature than the farmers of bygone generations left in the thousands of miles of stone walls one sees in this part of Massachusetts?

Not only did they have to clear the ground of a stumpage that yielded little as lumber by way of compensation, but also of a vast amount of loose rock that occurs so frequently where the soil is best.

The result was that fences were built, not with reference to the needs of height and width in field boundaries, but rather of dimensions sufficient to provide a storage place for the vast amount of rock that had to be removed before the plow and the harrow could make ready the soil or

Photograph by Leon H. Abdalian

FILLING TUBES WITH TOOTH PASTE: MASSACHUSETTS

The big containers are full of paste. Each girl can fill 10,000 tubes a day. Everywhere one goes in the Bay State labor-saving machinery is in evidence. Yet everywhere the more labor is saved the more work there is for labor to do.

the corn and wheat find a place to grow. Some of these stone fences are so thick that a carriage and pair could drive along the tops.

THE FARMER'S LOSING BATTLE

For more than two centuries the sturdy yeomen of Massachusetts waged an aggressive battle against the forests to obtain room for their crops. Then, in 1850, came a stalemate, and for thirty years the battle line between the field and the forest showed a little wavering, but no real change.

But when it seemed that a draw was the inevitable end of the struggle a new ally appeared on the side of the forest. High wages and short hours for labor in urban industries began to cause wholesale desertion from the forces of the farm.

Then the line wavered and broke; in

COTTON AS IT COMES INTO THE FACTORY

When cotton reaches the factory in the bale the fibers are kinky and tangled, like a bunch of snarled hair. One pound out of every four of the bale's weight is due to the dirt, sand, and other foreign substances in it. Massachusetts annually spins a million bales like the one shown here.

the thirty years, 1880-1910, that followed, the forest was able to retake from the field half of the territory the hardy farmer had won, and has left the State only a little more than a million acres of improved land where formerly it had considerably more than two million.

Nor is it to be doubted that this year's census will show even larger losses in improved land. One has only to motor through the better farming communities to see thousands of acres that have been abandoned recently, and to find "For Sale" signs along every highway; for how few farmers can withstand the lure of $40 a week for himself, $30 for his wife, and $25 for his daughter, with eight hours a day for everybody!

This tremendous slump in agriculture has taken place in spite of the fact that, acre for acre, the value of Massachusetts crops is probably higher than that of any other State in the American Union. Furthermore, it is in spite of the fact that some of the most fertile farming land in America is to be found in the Bay State adapted for the growth of specialties, seeds, onions, etc.

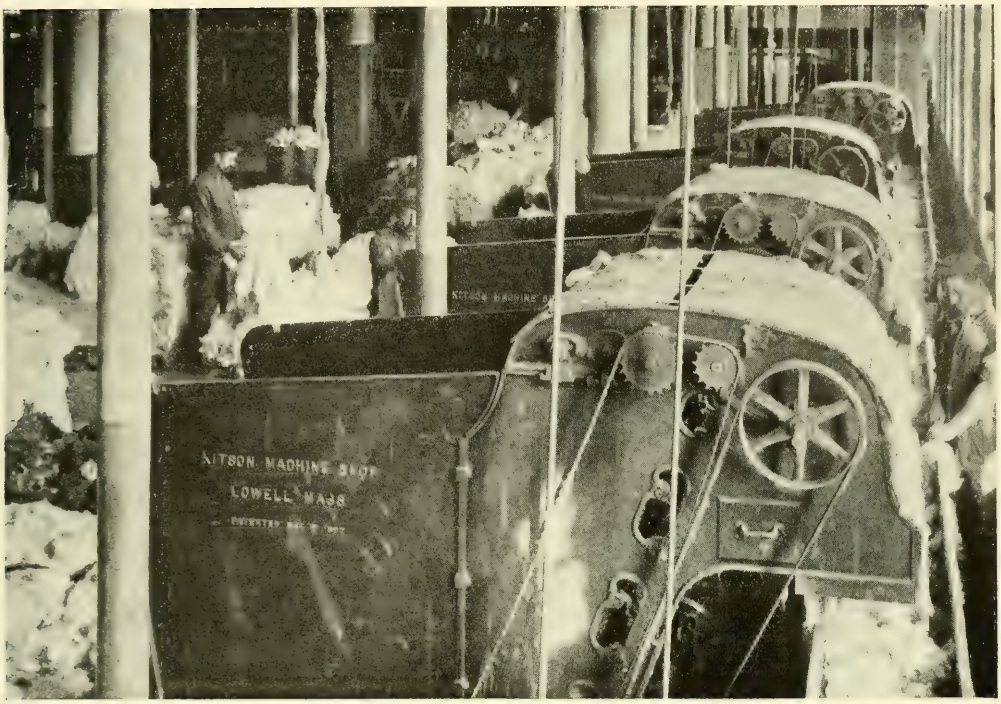
The Massachusetts Agricultural College is intelligently striving to offset the sweep of the tide that is carrying people from the farm to the factory. The task is a hard one and the odds against its accomplishment are tremendous, but much good is being done.

Massachusetts was one of the first to appreciate the advantage of good roads and to undertake a State-wide program of highway construction. Many millions of dollars have been spent in perfecting a system of trunk lines. The result is that the whole State is a paradise for the summer motorist, and tens of thousands of Americans gather in this vacation land, which can suit every taste and pocketbook.

A statistician has estimated that summertime visitors swell the population by one-fourth. That is probably an overestimate, but it gives some idea as to the influx of folk on vacation bent.

HISTORIC ASSOCIATIONS PRESERVED

Just as Massachusetts was a pioneer in recognizing the advantage of good automobile roads, it was also the first State to appreciate the development of its historic resources. There are mark-



THE BALE-BREAKER AT WORK

After the bale of cotton has been opened, the workmen feed it into the machine shown here. This machine loosens the mass and delivers it to an endless belt (shown on the right), which carries it to the feeders (see page 211).

ers from mountain to sea, telling in brief outline the history of hallowed spots. Only those who have traveled through the State can appreciate the extent of this work or realize how much it adds to a pilgrim's pleasure and stirs anew the Americanism within him.

The irreverent outsider may be disposed to smile at the fact that there is not an elm tree under which George Washington is known to have stood that does not bear a distinguishing legend. He may even think that the Bay State overplays its history.

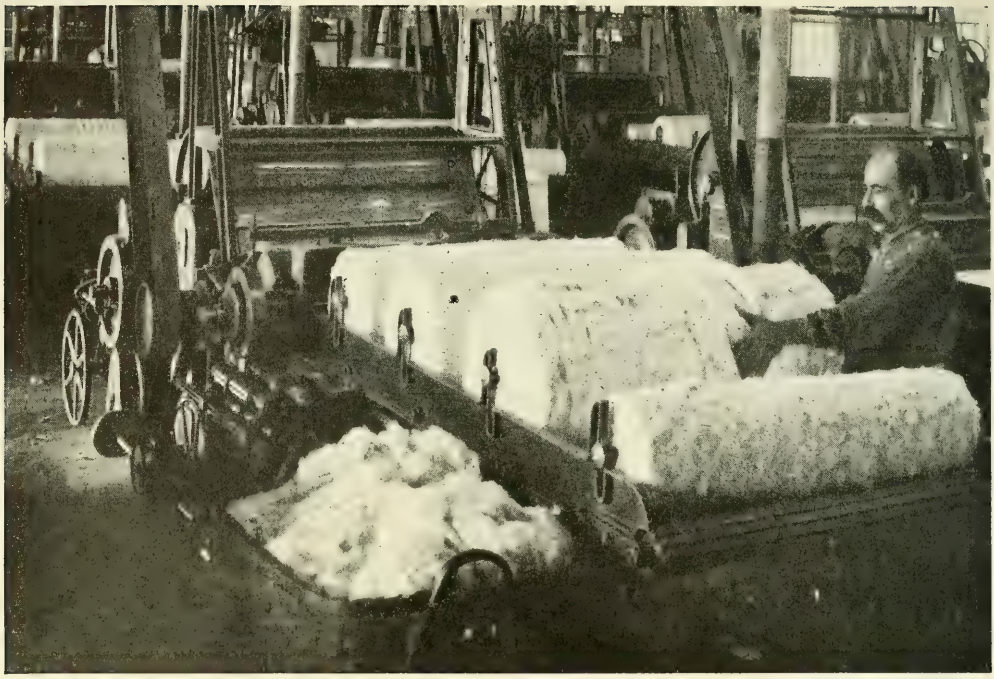
MASSACHUSETTS THE PATRON OF EDUCATION

But it were more nearly the truth to say that other States have underplayed theirs, and that every American would be a better American if all the States followed the example of Massachusetts in perpetuating the shrines of history in a way that would permit every passerby to read and reflect upon the nation's glorious heritages.

From its earliest days the State has led the nation in matters educational. Here the first colonial grammar school was established, the first college, the first elementary free school, the first academy, the first high school, and the first normal school.

Call the roll of the higher institutions of learning—Harvard and Holyoke, Amherst and Williams, Smith and Wellesley, Tufts and Massachusetts Institute of Technology, Clark and Radcliffe, Clarke Institute of Northampton, and many others—and most of them will be found to have been pioneers in their respective fields and to stand today each for some special ideal.

But Massachusetts is entirely democratic in her educational activities. The unfavored many have as much right to their opportunity for training as the fortunate few. High schools of excep-



THE INTERMEDIATE PICKER, WHICH CONTINUES THE WORK OF CLEANING RAW COTTON

From the bale-breaker the raw cotton goes through the feeder to the opener, and thence to the three "pickers," which still further loosen it and release each fiber from the grasp of its neighboring fibers. The four "laps" (the round cotton mass) of cotton on the machine are being combined into one lap (see picture on opposite page).

tional merit are to be found in every community and technical schools in the larger industrial centers.

In 1913 a law was enacted requiring every town without a high school of its own to pay tuition in other towns for its high-school pupils, and to pay their transportation back and forth, up to $1.50 a week, thus guaranteeing to every boy and girl in the Commonwealth who desires it a free high-school education. In 1918 another law was enacted granting State aid to struggling high schools.

As in so many other directions in the educational world, Massachusetts was a pioneer in exchanging the little red school-house on the hill, with its ungraded course of studies, its untrained teacher, and its poor facilities, for the consolidated school, with its fewer and better teachers, its carefully planned courses of study, etc. It did so on the basis that four good teachers in one consolidated school could teach twice as many children twice as much as eight poor teachers in eight little red schoolhouses.

Latterly the children at distant points have been conveyed to and from school at State expense. It costs half a million dollars a year to convey to school those children who do not live within walking distance, but that is only a trifle compared to the advantages which result from educating the 20,000 children affected. Of this number nearly half go by trolley, nearly a third by horse-drawn vehicles, and a fifth by motor busses. The figures indicate that it costs less to take the children to school in motor cars than in horse-drawn vehicles.

But with all the progress which Massachusetts has made educationally, there are still 600 teachers in the State with salaries of less than $550 a year. Adequate pay for teachers is recognized as one of the first requirements in any campaign for an improved education pro-

gram, and the Bay State is moving in that direction.

THE HOME OF THE CONVEYING MACHINE

Massachusetts has long been preëminent in the development and introduction of labor-saving devices, but in no field more so than in the evolution of automatic conveying machines.

Go into a chain drug store, a large department store, or a big business office, and the pneumatic tubes and cash-carriers installed there probably came from Massachusetts. Very probably your sterilized milk is handled in the dairy on Massachusetts-made gravity conveyers.

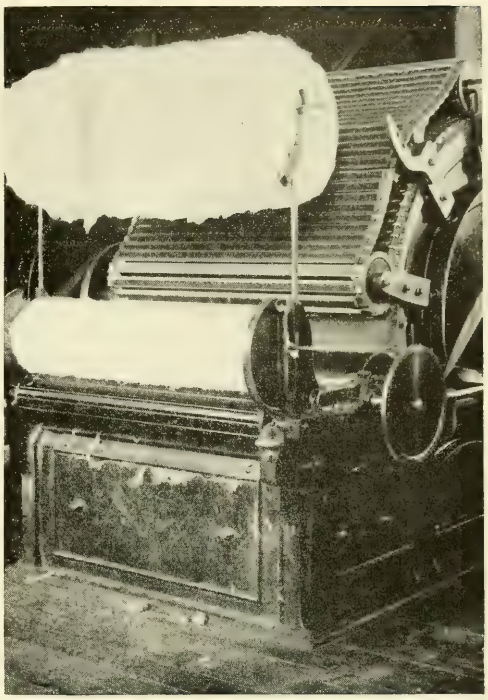
Indeed, at every turn one comes into contact with something that has been carried by these Massachusetts step-savers—mail, shoes, hats, watches, money, books, hotel food.

Mechanical messengers "made in Massachusetts," which are as fast as their human prototypes are slow, are found in every State. Some of them seem to act with even more intelligence than the lead-shod messenger of flesh. In one type there may be a dozen or more receiving stations along its route, but it unfailingly carries its burden to the one to which it is directed by the sender.

In a big bank the paying tellers cannot always tell the status of certain accounts when checks are presented; but down beneath the counter of their cages they have pneumatic tubes. Into one of these the teller puts the check in question; it is conveyed to the bookkeeper, who scribbles his initials of approval upon it, and before the patron at the window has time to suspect that the drawer's account is being examined, the check has been returned to the teller and payment is made.

MASSACHUSETTS ANNUALLY MAKES A SHOE FOR EVERY FOOT IN THE UNITED STATES

Space forbids even the enumeration of the many services performed by gravity, pneumatic and electric belt carriers, but millions of hours of labor, millions of dollars' worth of customers' time are saved every day in America by "made in Massachusetts" automatic messengers and merchandise movers.



A COTTON CARD AT WORK

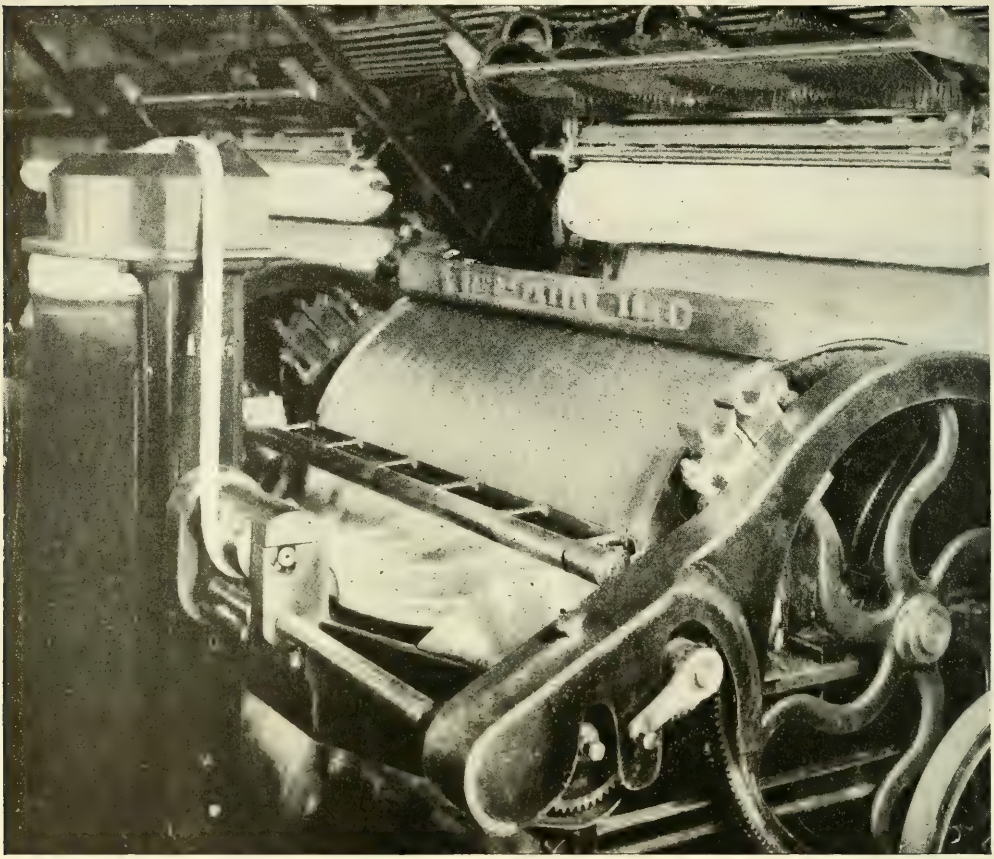
Here the big rolls of "lap" are fed between two cylinders which are covered with leather or cloth, studded with tens of thousands of tiny spikes. These barely miss each other, but they comb out the fibers of cotton until they all lie parallel to one another (see page 212).

The story of the factories of the Bay State is a narrative of an astonishing concentration of human endeavor.

In quantity no less than in value do the manufactures of Massachusetts amaze. A boot, shoe, or slipper for every human foot in the United States; more cotton goods than the whole world produced when John Adams was President; enough hosiery to cover 40,000 miles of feet and legs; sufficient woolen goods to put a twenty-foot bandage around the waist of Mother Earth—these are some of the yardsticks that measure the annual activities of this beehive of industry.

Of course, when one thinks of Massachusetts industry, the manufacture of textiles comes immediately to mind.

Think of twelve million flying spindles converting fiber into yarn and thread, each of them dancing around its own axis at rates varying from 5,000 to 10,000



THE DELIVERY END OF A CARDING-MACHINE

Here we see the "lap" spread out in gossamer-like thinness over the card cloth. The filmy sheet is then gathered into the "sliver"; the sliver is the white streamer clearly pictured on the extreme left. The second stage in the conversion of raw cotton into plain yarn now begins.

turns a minute. Placed end to end, these dancing dervishes of the textile industry would reach from Montreal, Canada, to Memphis, Tenn.

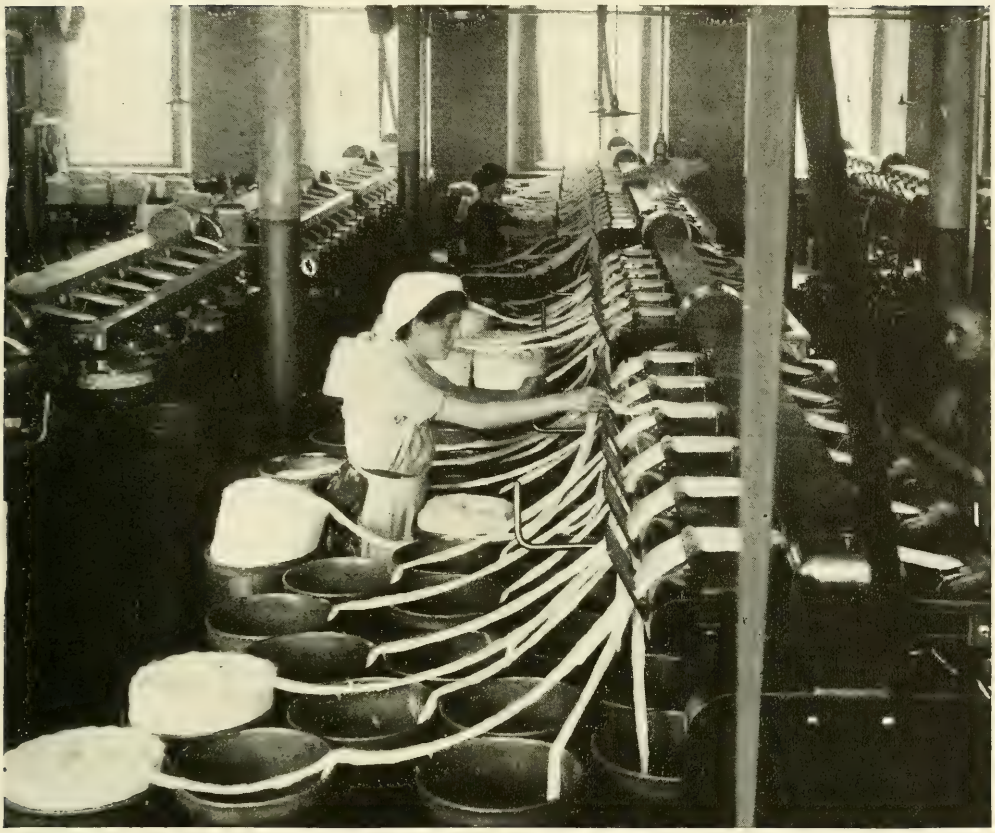
EIGHT MILES OF COTTON CLOTH MADE EVERY MINUTE

Then there are the looms, a quarter of a million of them. Put these cloth-making machines together, end to end, with no aisles between them, and the weaving shed required to house them would begin at Boston, Mass., and end at Wilmington, Del. Every third spindle and loom in the United States is humming away in the cities and towns of the Bay State.

Of the textiles, cotton is first, some two billion yards of woven goods leaving the cotton looms every year. That means cloth flowing from machines at the rate of nearly eight miles a minute! It is sufficient piece goods to make a woven belt long enough to hitch the moon to the earth and more than six feet wide! Of sheetings, shirtings, and muslins Massachusetts produces about thirteen yards for every person in the United States; of fancy woven material, nearly four yards; of napped fabrics, more than one yard; of velvets, corduroys, etc., nearly a yard.

THE STORY OF A YARD OF CALICO

A piece of simple calico seems a mere trifle; but the story of its manufacture is an epic of genius. Followed from the raw cotton in the bale to the bolt of cloth



"DRAWING" SLIVERS IN A COTTON MILL, ONE OF THE STEPS PRELIMINARY TO SPINNING

When the sliver comes from the card, as shown in the preceding picture, it is received into one of the cans shown here. Six of these slivers pass through the drawing frame, as explained on page 214, and are combined into one, as long as the combined length of the six, but of the diameter of one of the originals. Each sliver passes through a number of drawing-machines, each time entering as six and coming out united into one, and correspondingly lengthened.

in the warehouse, it leads one a merry chase up and down countless flights of stairs and keeps the mind busy enumerating the processes involved.

Lawrence has one of the largest cotton mills in the world and, connected with it, the largest print works in existence. Let us there follow the processes of converting cotton into calico. We shall appreciate the clothes we wear the more when the journey's end is reached.

When the cotton comes to the mill it is in the familiar bales of commerce, 500 pounds to the bale. After being opened, the cotton is fed to a machine known as the bale-breaker. Here the matted cotton is loosened and torn into small bunches, which are delivered to an endless belt that carries them to the "feeder" (see page 207).

The feeder is a machine containing a series of pin-studded slats which carry the bunches of cotton in regular quantity into the next machine, known as the "opener."

The opener gives the cotton a warm reception—a terrific beating, indeed. It has a shaft on which there are mounted two rows of arms. This shaft revolves at from 1,200 to 1,800 times a minute, so that the cotton gets from forty to sixty slaps a second. The result is that the

"SLUBBER" MACHINES AT WORK IN A COTTON MILL

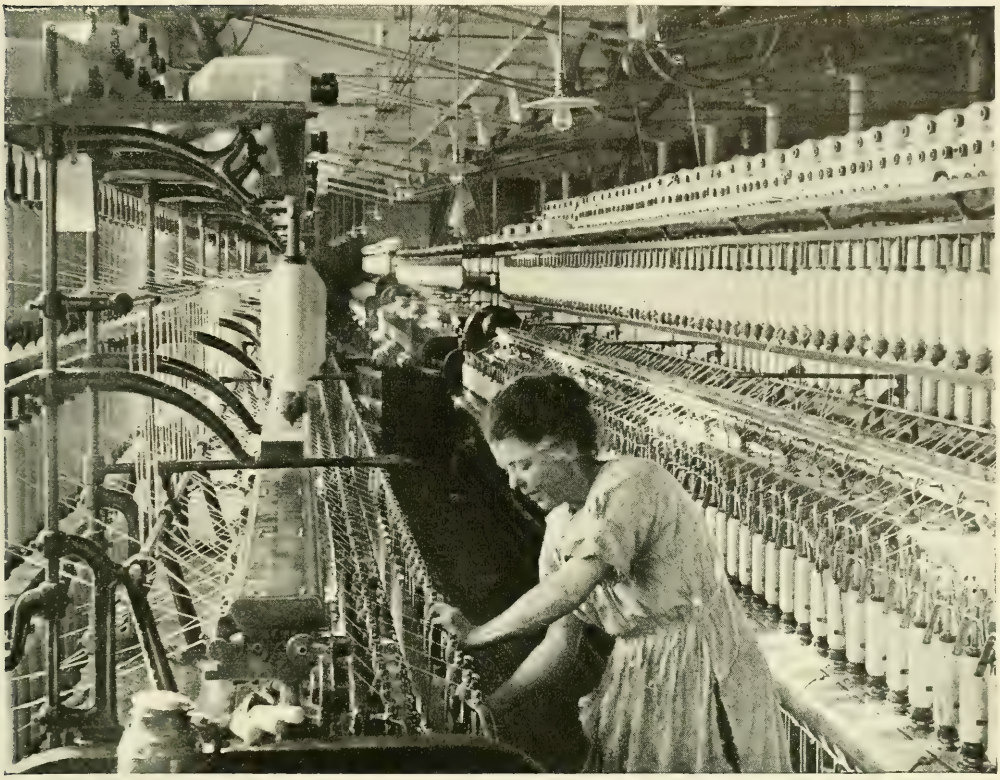
In this picture we see the slivers being drawn out of the cans on the right. As they pass through the slubber they are given a twist which makes each fiber take hold of its neighbor, and here they begin to acquire tensile strength. They emerge from the machine on bobbins as "roving." The cotton in the cans is "sliver," while that on the bobbins in the foreground is "roving" (see text, page 215).

sand and other foreign matter in the cotton lose hold. The opener then continues the work of picking the cotton to pieces. When the task is completed the staple is in tiny tufts. These are caught up by air suction, the dirt being left behind, and carried to the fourth machine, a "breaker picker."

The breaker picker gives the tiny tufts another beating, to remove persistent dirt, and then rolls them together in a great downy sheet on a rod. This sheet is known as "lap" (see page 208).

Four of these laps are fed simultaneously into a fifth machine, known as the "intermediate picker." Still another beater plies its flails upon the cotton as it comes in. The four laps that go into this machine come out as one.

In turn, four of these laps are fed into



THE FINE ROVING FRAMES IN A MASSACHUSETTS COTTON MILL

Here we see another step in the long process of converting cotton first into "lap" (pages 212 and 213), then into "roving" (page 215), and then into yarn. The machines in this picture give the roving the final stretching and twisting before it goes to the spinning frames, where it is converted into yarn (see text, page 216).

the sixth machine, known as the "finisher picker." It beats the cotton some more, and the four laps come out a further purified single lap, which looks like cotton batting—sixteen original laps condensed into one (see page 209).

After all these several and sundry beatings, one might think that no dirt would remain, but there are still some particles of leaf, seed pods, etc., clinging fast. Moreover, the fibers, which in ordinary cotton are about an inch long, are more or less matted.

So a seventh machine, known as the "card," is assigned the task of removing the remaining impurities, and of loosening or separating the fibers, so that they can be drawn parallel with each other. The card has two big drums, each covered with a wire-studded cloth and revolving so as barely to miss touching one another. There are some 72,000 of these projecting wires to every square foot and no fiber has a chance to escape its combing.

PREPARING TO MAKE THE THREAD

As it leaves the big drums the loose cotton is beautiful to behold. Perhaps forty inches wide, it is as thin as the skift of snow that falls on a late autumn morning. But promptly it passes through a set of reducing rolls which convert it into a rope about an inch in diameter, known as a sliver. This is coiled in a large can about three feet high and a foot in diameter (see page 210).

One might well think that, with such a great array of manhandling as this, the cotton would be ready for weaving; but in point of fact the process of reducing it to yarn is only barely begun.

A COTTON-SPINNER KEEPING THE THREADS OF ROVING RUNNING PROPERLY FROM BOBBIN TO BOBBIN

In spinning, the roving from the bobbin on top of the frame is fed through a little trumpet, and then through drawing rolls which further stretch the strand and make it smaller. After this it goes through a whirling piece of steel called the traveler, which winds it on another bobbin and gives it another twist. In the process of converting raw cotton to thread, the cotton fibers pass through six to twelve twisting-machines, depending on the quality of the thread to be produced.

The next step is to put the sliver through the drawing frames. Six slivers as they come from the card are combined into one in the first frame, which consists of a series of rolls, the last pair of which revolve six times as fast as the first pair, thus making the sliver that comes out of the frame six times as long, but of the same diameter, as the ones that went in. Six of these latter slivers, in their turn, are fed into the second drawing frame and transformed into one. The final frame takes six of these, in turn, and transforms them into one (see page 211).

In other words, just as the final lap is composed of sixteen original laps, so the

A DOFFER GIRL IN A LAWRENCE COTTON MILL

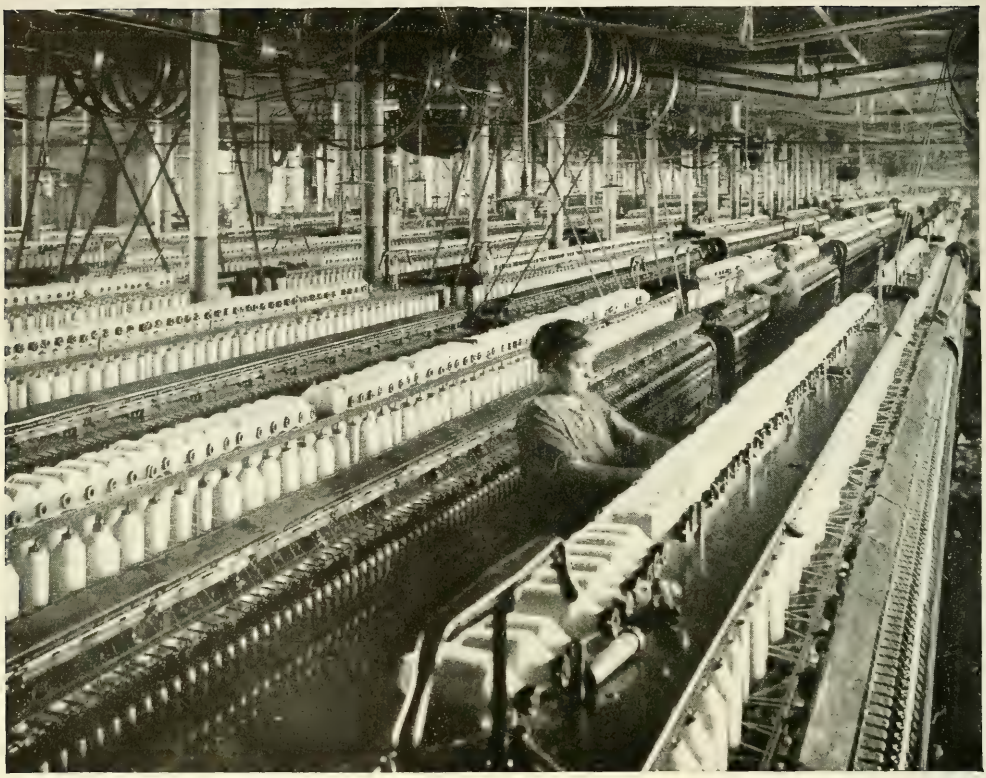
This young lady takes the bobbins from the spinning frame as they become full of yarn. Acres and acres of fast-flying spindles and whirling bobbins are found in Massachusetts. All the bobbins, placed end to end, would reach from Montreal, Canada, to Memphis, Tennessee.

final sliver is made up of 216 original slivers; but it has gained in length all that has been lost in diameter.

But up to date the sliver is only a mass of parallel fibers and has no strength whatever. The succeeding three operations are intended to give it a certain amount of twist, so that the fibers will cling together, while the size is reduced.

In the first of these operations final slivers from the drawing machine are fed into a machine known as a "slubber." It takes these and simultaneously twists and stretches them into one strand, much longer, but with a diameter reduced to that of a clothes-line; this it winds on a headless-spool bobbin. This resulting material is called "roving" (see p. 212).

Two strands of this roving from the slubber are next twisted and stretched



A SPINNING-ROOM IN A LAWRENCE COTTON MILL

The cross-threads, or woof, of cotton goods are not twisted as much as the lengthwise, or warp, threads. The function of spinning is to twist the fibers together tight enough to give the yarn or thread the desired strength. If a thread be completely untwisted, it will be found to be nothing more than a series of fibers an inch or an inch and a half long.

into one, which is wound on bobbins of the "intermediate frames."

Two of these intermediate rovings in their turn are twisted and stretched into a final roving, which has about the diameter of the string which the grocer uses in tying packages.

Sixteen laps to a sliver, 216 slivers to a roving, 8 rovings to a strand of yarn—27,648 doublings from original lap to unspun yarn!

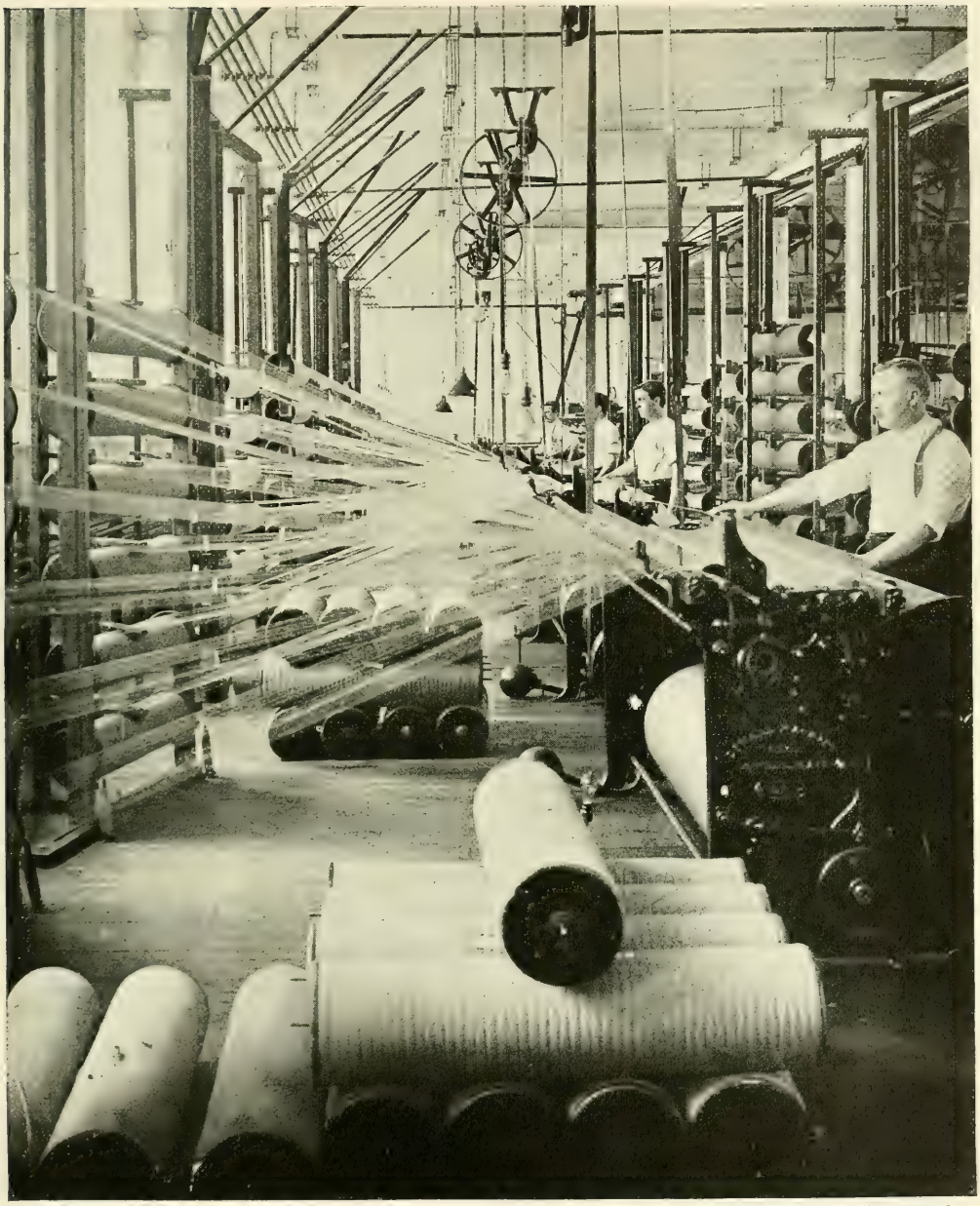
The bobbins containing the final roving are now set up on the creels in the spinning frame. A strand of the roving goes through a trumpet and then through a set of three rolls running at different speeds, which still further stretch it, until it becomes the size of yarn wanted. Next it passes through a small rounded piece of steel, called the "traveler," which runs at a very high speed—sometimes fifty miles an hour—on a ring, in the center of which is the fast revolving spindle. From the traveler the yarn is wound on the bobbin on the spindle and gets the required twist.

If the yarn is intended for "woof," or across-the-goods thread, it is wound on appropriate bobbins and is ready for the loom. The cotton has passed through fourteen machines to reach the woof stage—seven, up to and including the carding machine, three drawing machines, three roving machines, and the spinning frame.

MAKING THE WARP THREAD

But if it is to become "warp" thread, that which runs lengthwise of the goods, the yarn has yet to go a considerable journey.

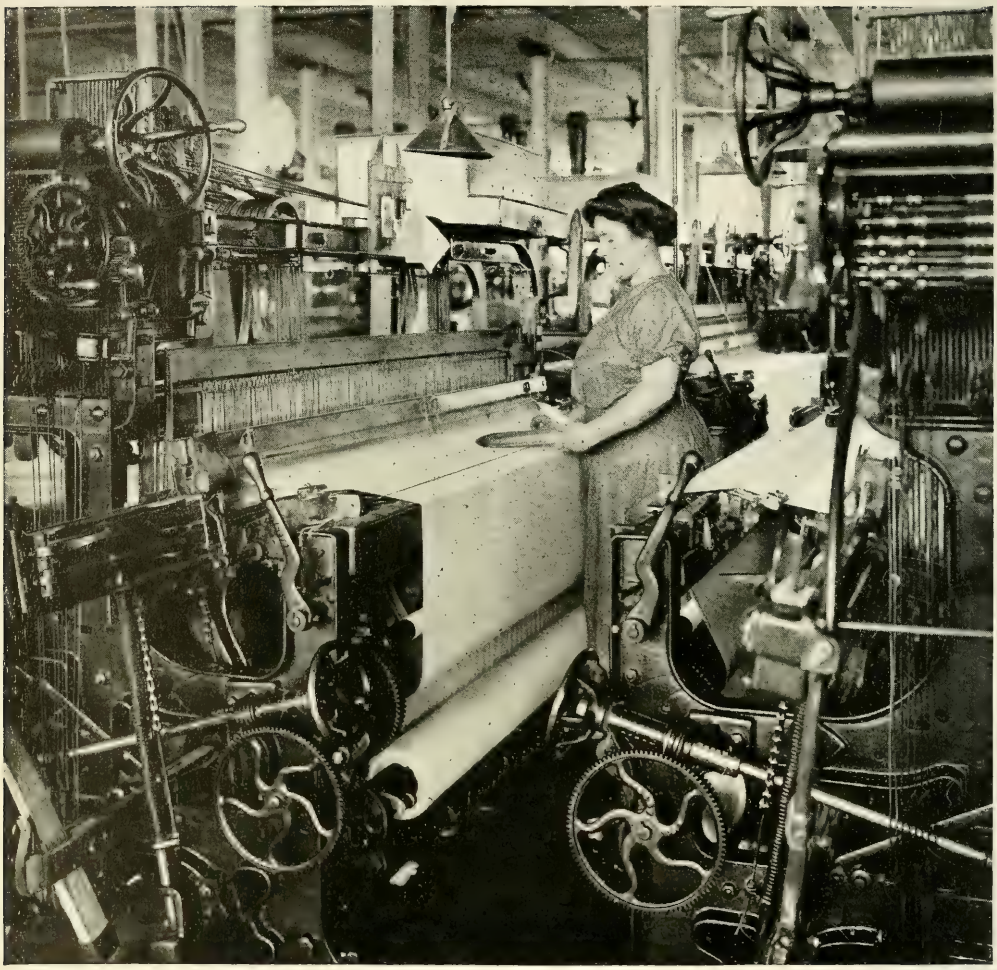
The bobbins of warp are taken from



© Underwood & Underwood

A WARPING-MACHINE IN AN UP-TO-DATE TEXTILE FACTORY

Here is shown the process of assembling the warp threads on the "loom beam" ready for weaving cloth. After the yarn has been sufficiently twisted to give it the required strength for warp, it is wound on spools. The contents of these spools, in turn, are wound upon the large rolls seen in the foreground, some 400 threads to the roll. These rolls are placed in the creel, or frame shown at the left in this picture, perhaps six at a time. There the threads are unwound from them, and, passing through a "slasher," or stretching and drying machine, they are consolidated on one great roll known as the loom beam. The loom beam may be seen on the right. With its load of thread, perhaps 2,400 individual strands, this loom beam is put into the loom (see next page, 218), and each thread through its particular "eye" in the loom harness, and then the conversion of thread into cloth—weaving—is ready to begin (see text, page 220).



© American Woolen Mills

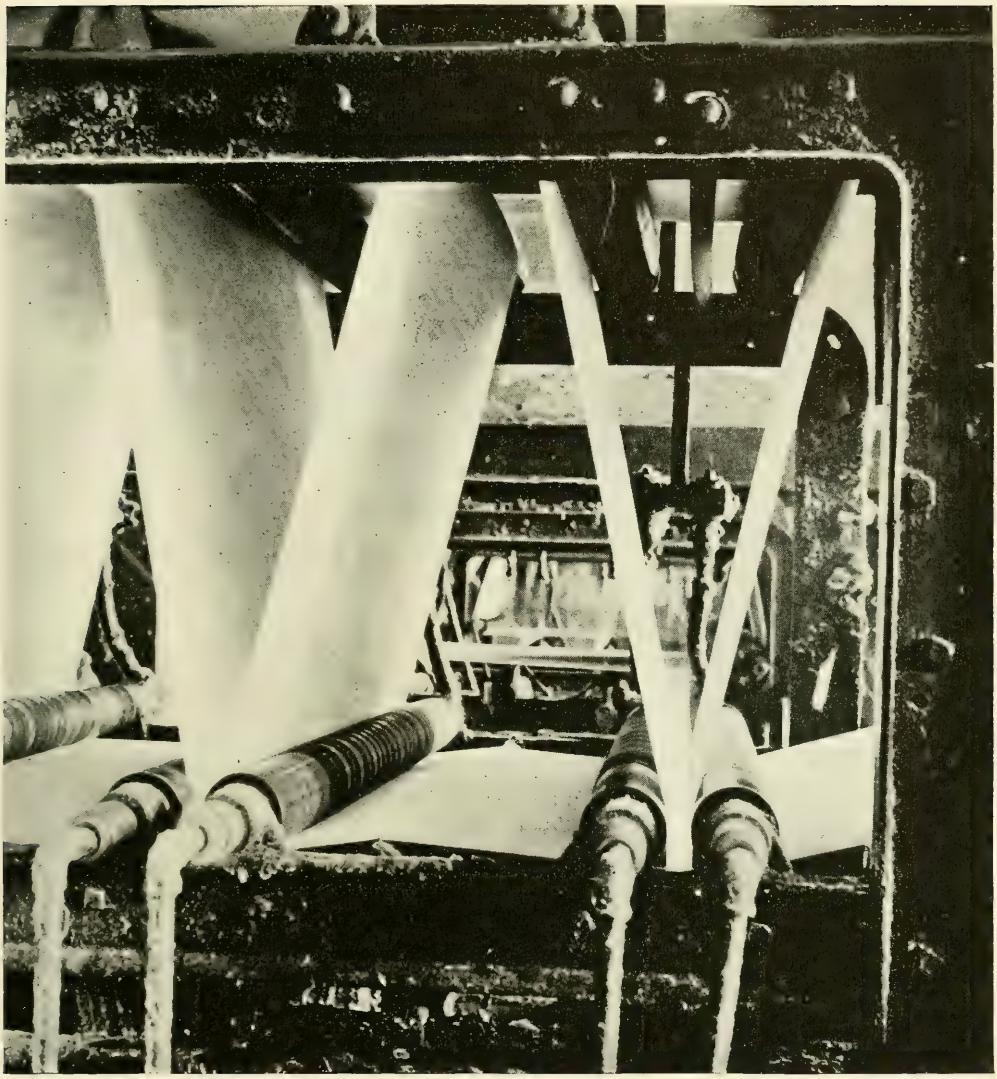
A GROUP OF LOOMS IN A MASSACHUSETTS MILL

These are the machines that receive the loom beams shown in the preceding picture and convert the yarn into cloth, weaving the warp and the woof together. In the simplest woven goods the shuttles containing the woof ply back and forth across the loom, passing under each alternate warp thread and over the others. In the fancy weaves the warp may go through half a dozen or more harnesses, instead of the two used in simple weaves.

the spinning frame and put on the "spooler." Here the yarn is wound upon large spools that hold about a mile of thread. For tying the ends together, the girl in charge of the spooler has a novel knot-maker that fits in the palm of her left hand. She takes the two ends, places them across a little hook, shuts her hand and opens it again, when, presto! the knot is neatly tied and the ends cut off!

After the warp is wound on the spools, three or four hundred of the latter are set in a frame known as the "warper creel." These threads are all tightly wound, side by side, on a big reel, known as a "warper beam."

To make an average piece of goods forty inches wide requires about two to three thousand warp threads; if 2,000, five warper beams, each containing 400 threads, are put into a machine known as the "slasher." Their yarn is unwound and passed through a box of hot starch and then around two copper cylin-



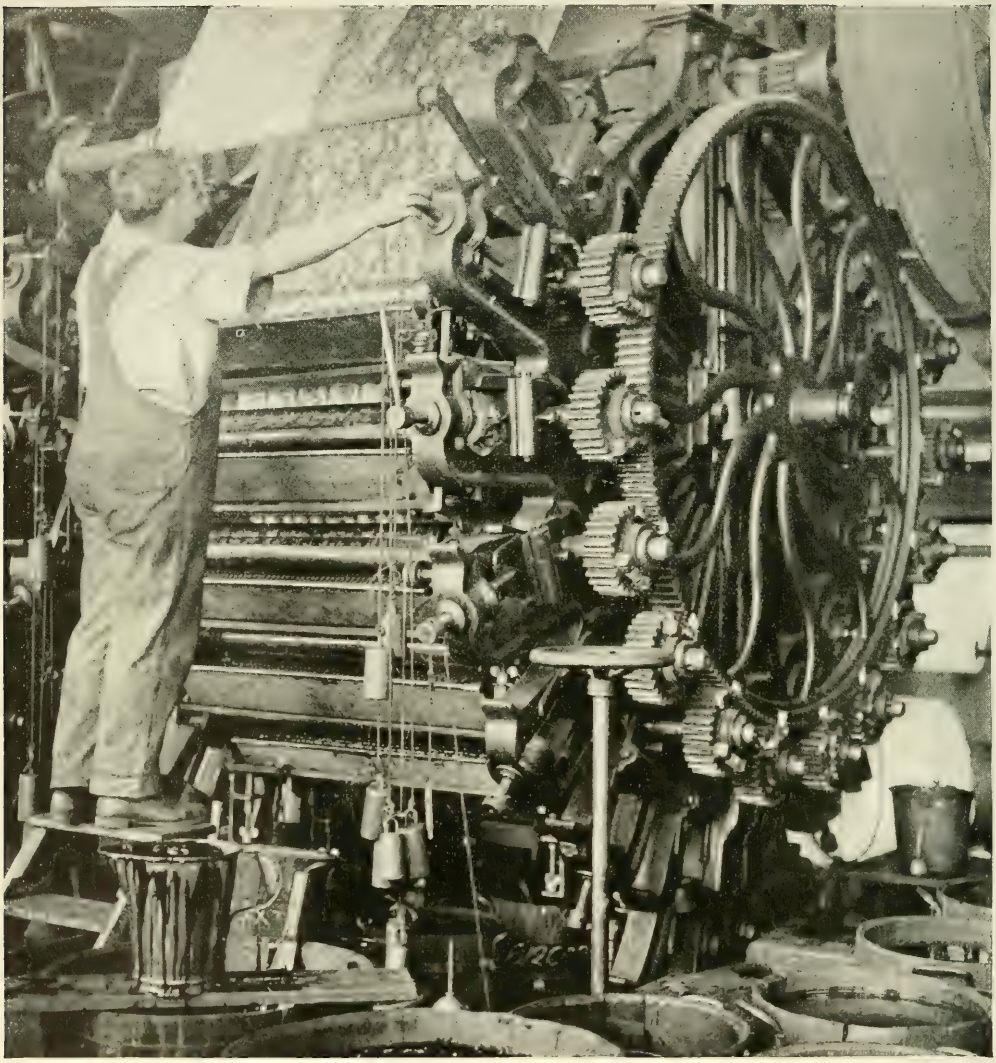
SINGEING CLOTH PREPARATORY TO PRINTING

Before cloth can be printed, all the little knots and threads and fuzz must be eliminated. A machine working on the principle of a lawn-mower first passes over it and eliminates all the knots and threads. Then the cloth goes through a singeing-machine, passing over a gas flame at a speed which permits all the fuzz to be burned off, but which saves the cloth from being scorched.

ders filled with live steam. Thus starched and dried—a process serving to make the yarn less apt to tangle and less liable to injury by the friction of the shuttle—it is wound around the "loom beam."

When the housewife uses her sewing-machine she has to "thread" it first. So, also, in weaving, the loom must be threaded with the warp. For plain weaving there are only two sets of "needles" to be threaded. These are known as harness, and consist of wires or twine cords, each with an "eye" in the middle. Each alternate thread goes through an "eye" of one harness, and the others through the corresponding "eyes" of the other harness.

Fancy weaves require more harnesses



A CLOTH-PRINTING MACHINE: LAWRENCE, MASSACHUSETTS

To see white cloth entering one of these big presses and coming out at a speed of thousands of yards an hour, with a dozen different colors, every one in perfect register, is to realize how much science has done to give us attractive clothes.

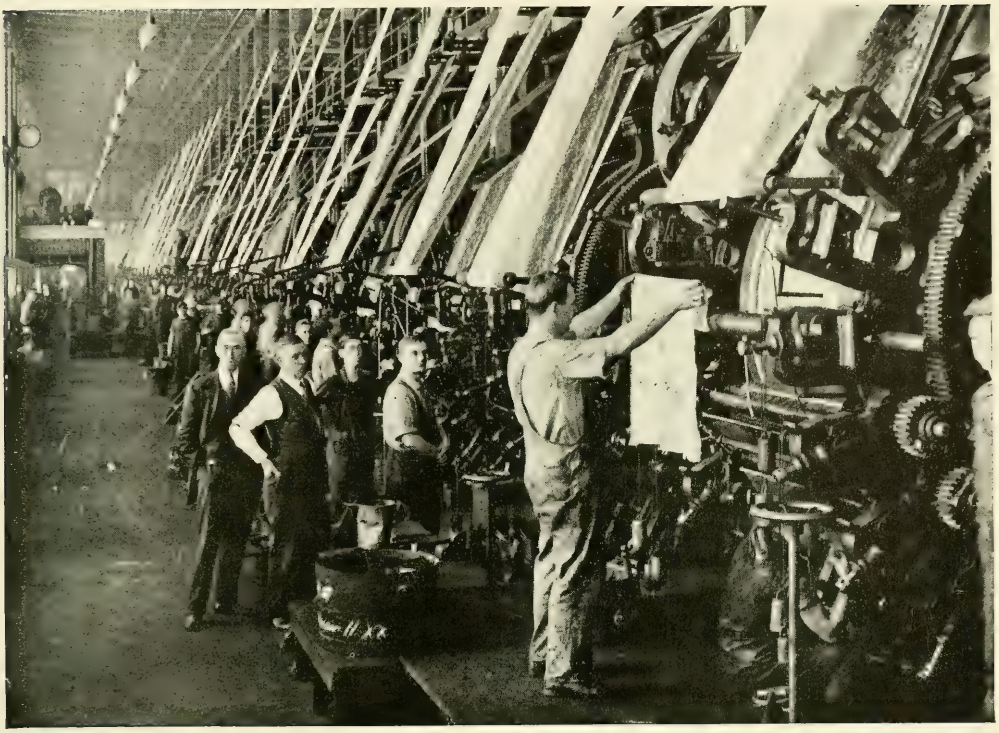
and complicated threading, but they need not be described here.

HOW THE CLOTH IS WOVEN

In the weaving process for plain cloth the one harness goes up as the other goes down, so that the shuttle with the woof passes under every other thread and over the alternate ones. Next trip through it passes over the ones it went under before and under those it passed over.

When a new lot of identical warp is to be put into the loom, the slow process of threading the harness is not resorted to; rather the ends of the old are knotted to the ends of the new.

To tie 2,000 knots is no mean job. It is performed by a little machine that can tie 240 knots a minute—four a second. The ends of the threads of the old warp are placed alongside those of the new and the tying mechanism set in motion.



A BATTERY OF FORTY-EIGHT PRINTING-MACHINES AT WORK: LAWRENCE, MASSACHUSETTS

One Massachusetts cotton mill produces five hundred miles of cloth a day, and a large percentage of this passes through the printing-machines here shown, said to be the largest group of its kind in the world.

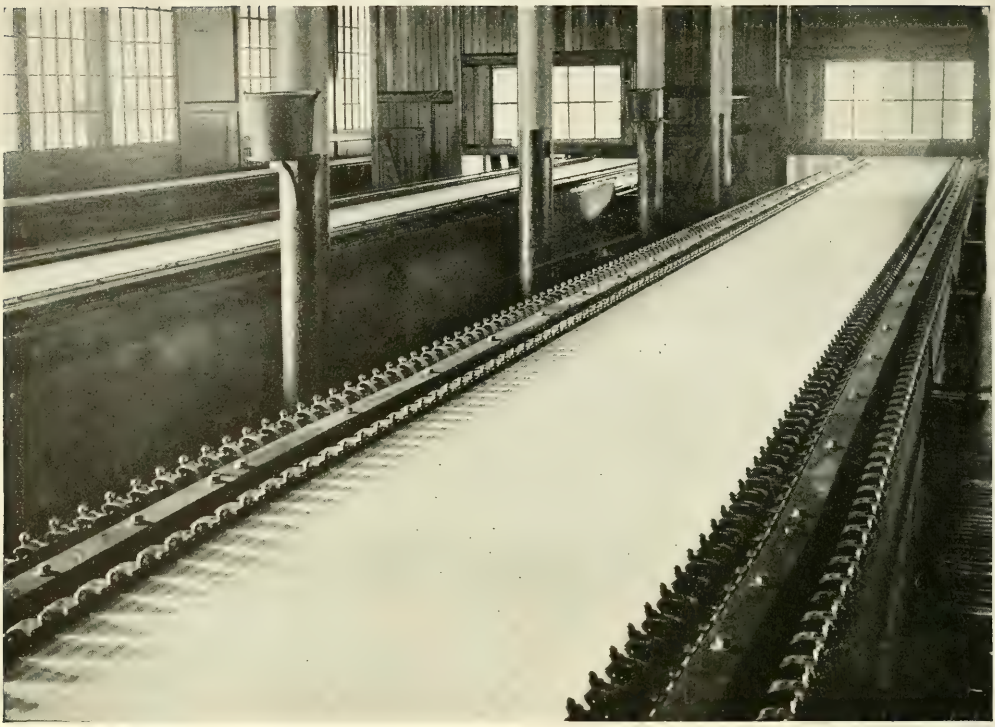
It rattles off the knots about as fast as a machine-gun pumps out bullets. If it fails to get both ends properly in its grasp, it makes a second effort. If this be not successful, it tries a third, a fourth, and even a fifth time. If it still fails, it stops and refuses to budge until the attendant gives it the missing thread.

With 24 miles of looms and 62 miles of whirling spinning-frame bobbins, to say nothing of pickers, drawing frames, rovers, and spoolers, and with an output of five hundred miles of cloth every working day, it is but natural that the Pacific Mills of Lawrence should require every device to prevent defective work. If a drawing frame did not stop as soon as a break in the sliver occurred, or a warper as soon as a thread pulled apart, or a loom as soon as a thread in the warp snapped, there would be defective material at every stage of the proceeding. So every strand passes through its own little guide, which consists of a tiny lever. The moment the thread breaks this lever is released, and by its own weight shuts off the power and stops the machine.

Our cloth is now woven. It is known as "gray" cloth in the mills, but at the dry-goods stores is called unbleached muslin. After careful inspection to locate imperfections, it is sent to the print works.

REMOVING THE FUZZ FROM CLOTH

Here it goes through another long series of operations. In the first place, it must be made into great rolls, like the paper for a newspaper press, so the ends of many pieces are sewed together. This makes possible the handling of many yards in one length. Many operations



STRETCHING CLOTH IN THE TENTER IN A MASSACHUSETTS PRINT WORKS

After the cloth has been printed, it is thoroughly dried, and then filled with steam, so as to make the colors "fast," or, paradoxically, to prevent them from "running." After that it is washed and dried again, then starched. Following the starching, it is put into the tenter frames. These are about one hundred feet long and have an endless chain on each side and steam pipes underneath. In them the cloth is dried and stretched to a uniform width.

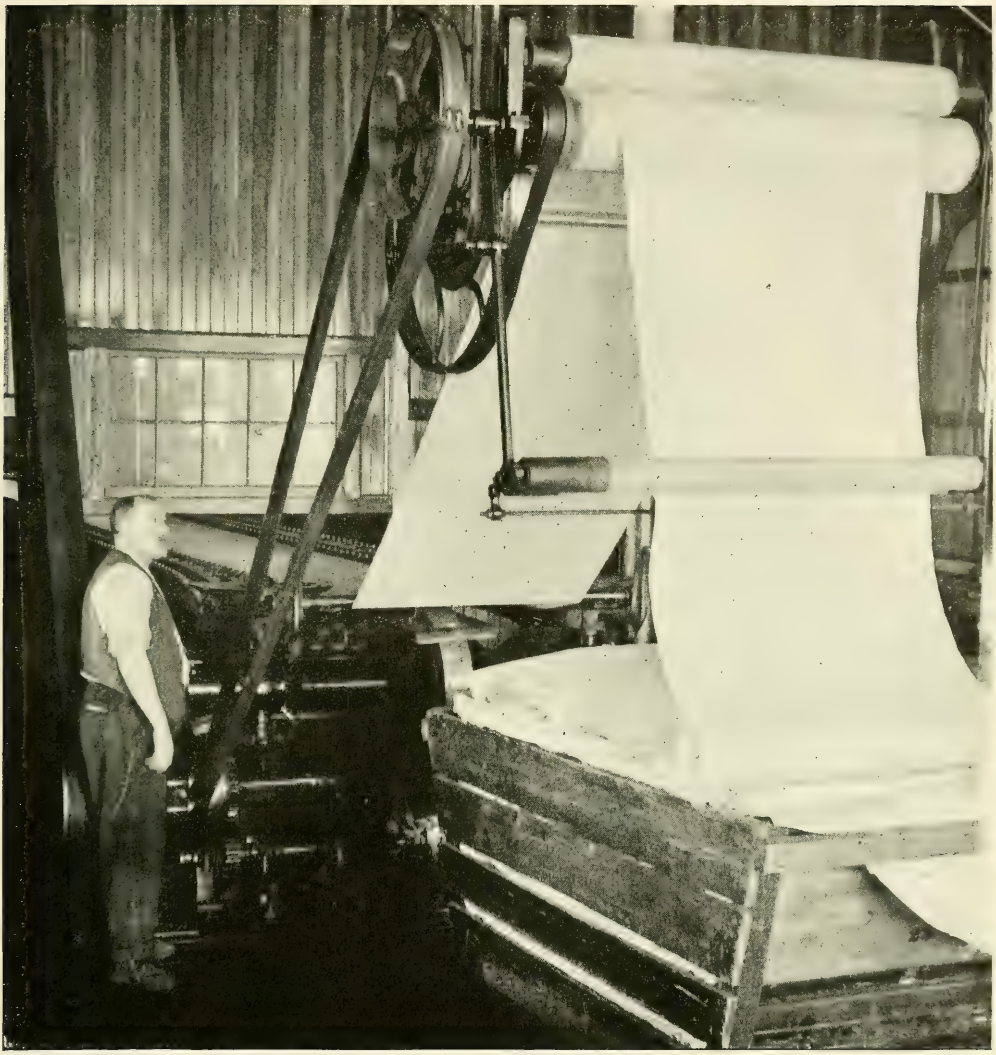
are continuous, and to stop often means waste.

As the cloth comes from the looms it has a loose fuzz all over the surface, and if the operators tried to print on it in that condition, they would get about the same result that is secured when trying to write on coarse, rough paper with a sharp-pointed pen—the lint adhering to the pen causes the ink to spread and make blotches. To overcome this the cloth is first put into a machine called the "cotton shear." This acts like a lawn-mower, clipping off all loose threads and knots and trimming the edges.

But still the lint adheres, and it must be removed before the cloth is in condition for printing. Whoever has watched a housewife singeing a chicken after picking it can understand both the reason for and the method of singeing the cloth. It is passed around rollers and through a gas flame at just such a speed that will allow the flames to burn off all the lint, but will not let it scorch the cloth.

From the singeing machine the cloth next goes to the bleaching kettles—kiers, as they are known in the print works. Here it is boiled for about twelve hours in a solution of caustic soda. Then it is washed and soaked for several hours in bins containing dilute acid, which takes out iron rust, stains, etc. It next gets another twelve hours of boiling, another washing, and another trip through a solution of bleaching powder. After that it is put into a pit and allowed to steep for several hours.

The effect is similar to the sun-bleaching on the grass out in the door yards of our grandmothers. It becomes pure white instead of dirty yellow, and more readily absorbs the dye when it goes through the printing machine. Once more it is washed



CLOTH BEING DELIVERED FROM THE TENTER TREATMENT

The cloth is laid out in neat folds by the swinging arm of this machine, vibrating back and forth. It is then taken to the presses, where it passes between heavy polished steel rollers and receives its ironing (see text, page 225).

and then dried by being drawn over copper drums filled with hot steam, after which it is wound into big rolls about the diameter of a large bass drum. It is now ready for printing.

Suppose our piece of calico is to be printed with a design of eight colors. Eight rollers are etched, and the eight pots of dye, or "color," mixed, the mixtures consisting of gums from Asia and Africa, starches from Iowa, and dyestuffs from everywhere, boiled and reduced to the consistency of glue.

The printing-machine is a large iron frame supporting a cylinder four or five feet wide. Arranged around it are the copper rollers, each ready to put on its color as the cylinder revolves, bearing the cloth to each in turn.

Each of the eight rollers runs in its own particular pan of color. A revolving brush spreads the color on the rollers,

FOLDING FINISHED PRINT GOODS: LAWRENCE, MASSACHUSETTS

Here the cloth is folded in layers a yard long. Forty yards make a bolt, and this is cut off and folded by hand. It is then ready for market.

and a sharp knife scrapes off all except that which is left in the little groove etched for the part in the pattern. As the roller comes into contact with the cloth the color is transferred to its proper place.

From roller to roller the cloth passes, until it has received its full assortment of colors, each in its exact place, and with the base color added last.

The color must be dried in the cloth, so it is passed over a series of steam-filled drums, then put into iron boxes filled with live steam.

But even now your handful of cotton has not become your yard of calico. The cloth must be washed and dried and passed through boxes of hot starch.

It is put into a tenter-frame and stretched and dried. This frame is about a hundred feet long, underlaid with steam-pipes. On each side is an endless chain having clips which grip the edges and stretch the cloth to a uniform width.

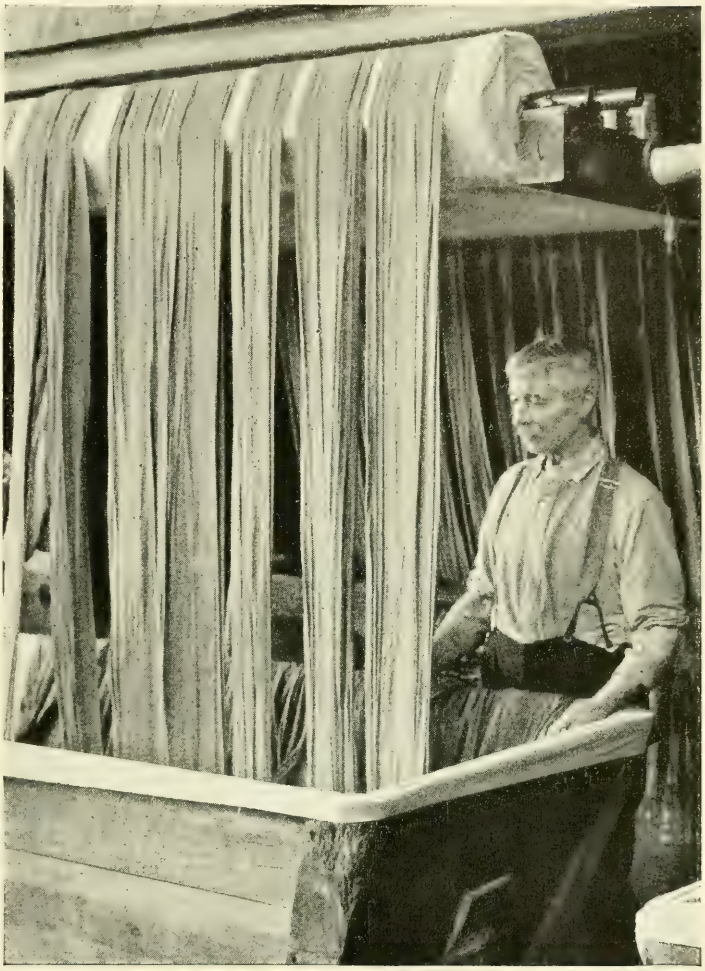
Then follows the ironing process. To iron four or five million yards of cloth a week would be too much of a task for even a regiment of laundresses; so great presses having polished steel rollers are employed. They put a tremendous amount of mechanical "elbow grease" on the fabric, and as it comes through this final stage it is ready to make its bow as "finished" calico.

Finally, it is mechanically measured and cut into forty-yard lengths, after which it is folded into the shape one sees it in the dry-goods stores.

A long story, this converting cotton into calico! Forty different machines to pass through, for a kind of cloth that before the war became so cheap as to lose caste as dress goods.

The processes of spinning yarn and weaving goods in the wool industry are not dissimilar to those employed in the cotton mills, though the preparation of the wool is different in that before it can be used it must first be scoured to get the grease out of it.

The total output of the looms of Massachusetts, in pure woolens, amounts to about 115,000,000 square yards a year—enough to make a blanket a mile wide and thirty-seven miles long. This is more than a third of all the woolens made in the United States. In addition, the State produces almost as much more goods that are either a mixture of cotton and wool or have cotton warp and wool filling.



DYEING CLOTH IN A LAWRENCE MILL

Goods are given their color in three ways: Some goods are dyed in the yarn, so that fancy patterns can be made by the weaving process. Others are dyed in the piece; these are solid color goods. Still others are printed by processes explained elsewhere in this article (see text, page 223).

Silk differs from cotton and wool in its preparation, in that it is a long thread and not a short fiber. In the article entitled "The Industrial Titan of America," in the May, 1919, number of THE GEOGRAPHIC, the story of silk up to the weaving stage was told.

MASSACHUSETTS SILKS

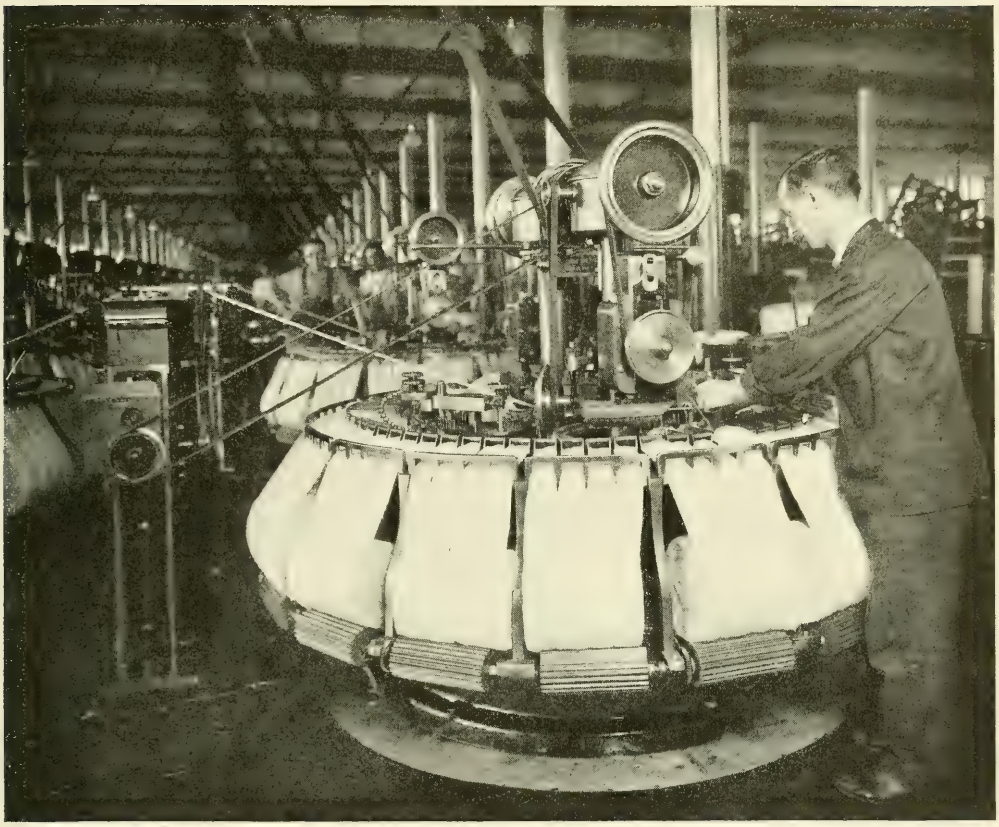
Holyoke, Massachusetts, is the home of what is perhaps the purest silk goods made in America. Though the prices of raw silk have risen from $4 to $12 a

CARDED WOOL IN A MASSACHUSETTS WOOLEN FACTORY

There are two objects in combing wool: first, to straighten the fibers and lay them parallel to one another, and, second, to eliminate the short fibers. The long fibers are used in the higher-grade yarns.

pound, and the temptation everywhere is to "load" it with tin, so that much of the silk goods one buys today has more metal than fiber in it, and consequently "cuts" and wilts away in a manner very disappointing to the wearer, a few manufacturers still adhere to the production of "unweighted" silks.

Pure silk is one of the most durable of all cloths. One may judge of its lasting qualities from the experience of a Massachusetts manufacturer whose silks are known everywhere. A half century ago his little mill, nestling close to the eastern slope of the Berkshire Hills, was caught in a flood that carried it away. To this day little bobbins of the silk from that mill are sometimes upturned by the plows of the farmers in the valley below. The wood of the bobbin has rotted away, but the silk fiber remains as strong as the day it was wound.



Photograph from American Woolen Company

A WOOL-COMBING MACHINE IN OPERATION

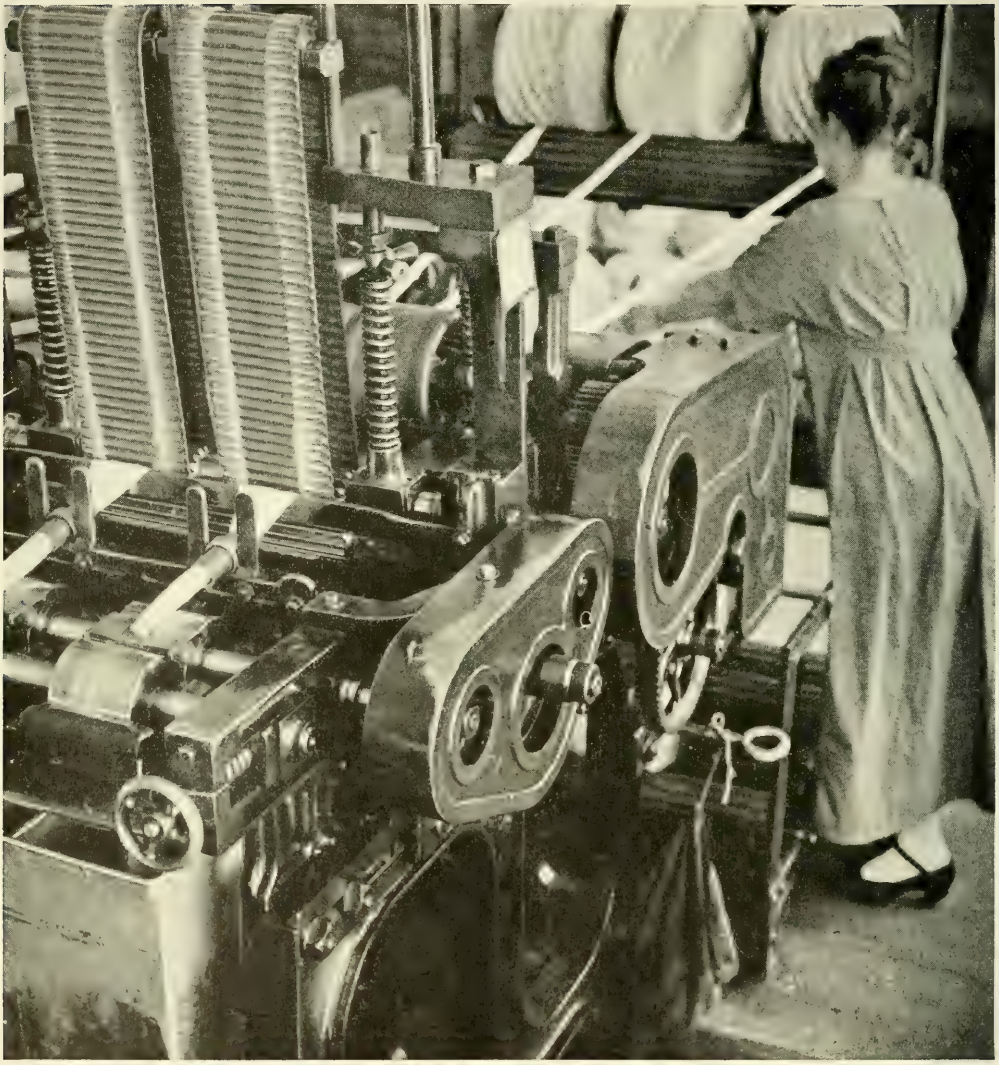
Here the fibers are being combed out and placed parallel, ready for the twisting that converts wool into yarn.

Do pure silks cost much in these days of skyrocketing prices? With the raw silk at $12 a pound and the throwing, dyeing, and weaving all done by wage-earners who command the best wages paid in the entire textile industry, it could hardly be otherwise. But the woman who demands the silk as the worm spun it never knows what it is to have silk "cut." She can distinguish the pure from the "loaded" silk by the simple test of putting a match to a tiny piece of it. If it burns quickly and cleanly, leaving a soft, grayish-black ash, it is pure silk. If it smoulders like punk, leaving a red, gritty ash, it is "loaded" with tin.

ENOUGH SHOES TO COVER 1,000 ACRES

The American people would either be a very poorly shod folk or else would have to import vast quantities of footwear, if it were not for Massachusetts. Two out of every five Americans one meets are shod with Bay State shoe leather. The men of the nation wear more shoes than the women, and the factories of the Pilgrim Commonwealth produce proportionately more shoes for men. If all the shoes manufactured in the Bay State every year were set side by side and end to end, they would cover nearly a thousand acres of ground.

To satisfy the demands for footwear, Massachusetts has to make heavy drafts upon the animal world. The shoe manufacturers of the State usually carry in stock the skins of more than 135,000 kangaroos and wallabies and a third of a million high-grade sheepskins. Nearly 3,000,000 goats and kids go to the slaugh-



"DRAWING" WOOL IN A LAWRENCE WOOLEN MILL

In the transformation of combed wool into unspun yarn it is passed through from six to nine machines, each of which unites many slivers of its predecessor into one of its own. For instance, in the first machine six slivers are united into one, stretching one yard into eight yards. In each drawing that follows a number of the next preceding slivers are consolidated into one and drawn out, so it often happens that a single strand of worsted yarn is the consolidated and drawn-out product of hundreds of thousands of original slivers as they came from the wool-combing machine. One inch of original sliver may share in the making of several miles of thread.

ter pen every twelve months to give milady shoes for her dainty feet. A million ordinary sheep and lamb skins and as many more calfskins represent the normal stock of Massachusetts manufacturers, to say nothing of the thousands of hides that come from cattle and horses.

It is a far cry from the village cobbler who pegged his life away over his lasts to the Massachusetts factory with its thousands of hands, its scores of processes, its dozens of kinds of machines, and its millions of shoes.

At Brockton one may see more shoes

Photograph from American Woolen Company

INSPECTING THE FINISHED CLOTH IN A WOOLEN MILL

In weaving it is inevitable that threads occasionally break and that knots appear. Expert menders go over the cloth yard by yard and mile by mile, with eagle eyes, for defects that they mend with astonishing speed and skill.

being made than in any other city on the globe. It is interesting to journey there and see how modern men are shod.

First of all, it will be discovered that Brockton is preëminently the man's shoe town. Lynn claims first place in the manufacture of woman's shoes, and Haverhill prides itself upon being the slipper city of the world.

Being the greatest shoe-wearing as well as the leading shoe-producing country in the world, the American market is such a large one that not only do cities specialize in types of shoes, but manufacturers carry the specialization even further. Massachusetts makes more shoes than Great Britain or Germany and has an export trade that reaches ninety countries and colonies.

Following a stream of shoes through a factory from uncut leather to ready-to-wear product may be rather a long ram-

Photograph by Leon H. Abdalian

CUTTING "UPPERS" SHOE LEATHER IN A MASSACHUSETTS FACTORY

The average American wears three pairs of shoes a year. Massachusetts makes nearly half of them. For the pedigree of a shoe see text below.

ble, but the trip shows to what perfection the Yankee shoemaker has carried the art of quantity production.

FOLLOWING A SHOE THROUGH A BROCKTON FACTORY

Before going on this pilgrimage, which is in a factory making a specialty of welt shoes, it must be remembered that there are four general types of footwear, according to the manner in which the soles are attached to the "uppers." The leading type is the welt. It has a small strip of leather sewed fast, first to the upper, and then to the sole, so that upper and sole are not joined directly. Welt soles are used mainly in higher-grade men's and boys' shoes and in women's walking shoes.

The McKay sewed shoe is the second type. In it the sole is sewed directly to the upper. The cheaper grades of stiff-soled sewed shoes are made by this method.

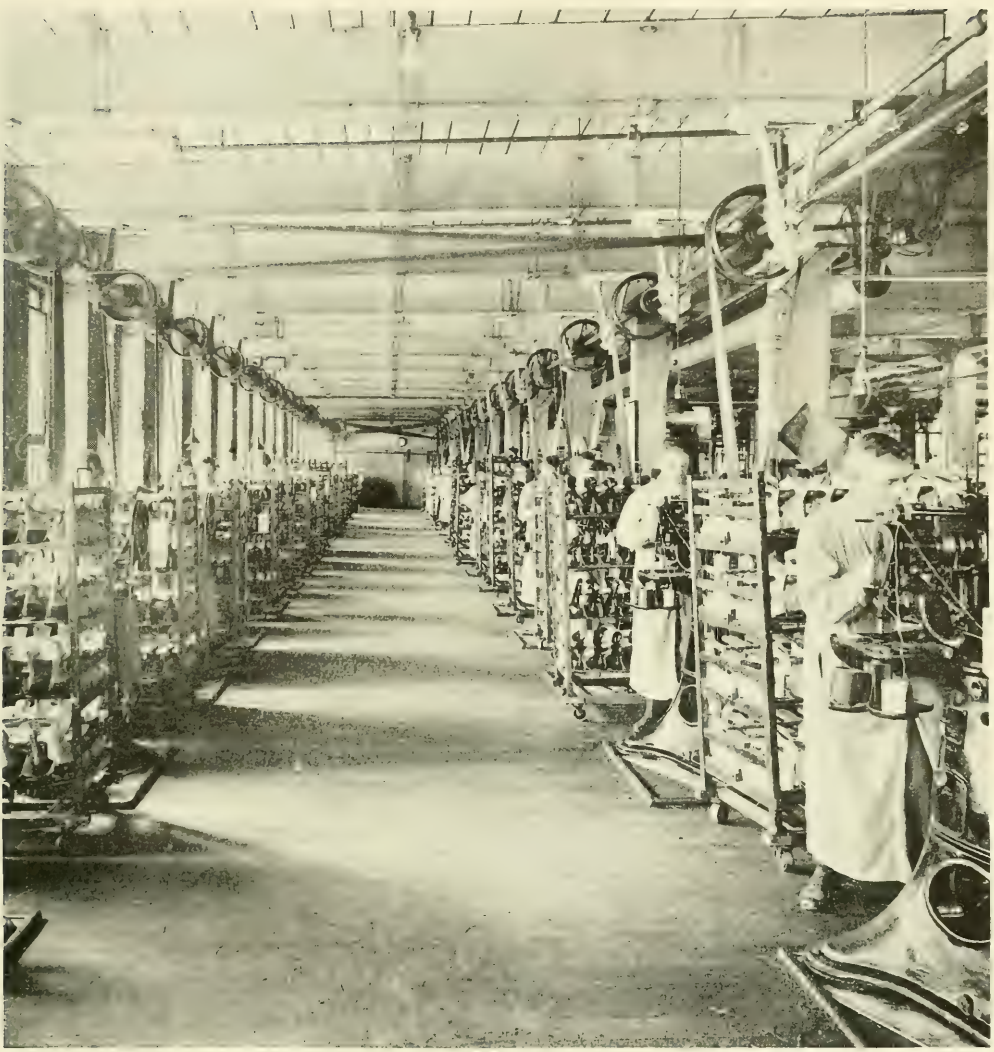
The turned shoe is the third type. In it the sole is joined to the upper with the whole shoe inside out, then turned. Women's pliable-soled shoes are made in this fashion.

The nailed, pegged, or screwed-on sole represents the fourth type and goes with cheaper grades of shoes.

A merchant in Bethesda, Maryland, say, has sent to the factory we are to visit an order for ten dozen pairs of shoes. After the order is entered upon the records four sets of tags are made out. One set goes to the uppers material department, another to the uppers stitching department, the third to the sole-leather department, and the fourth to the making department.

A MASTER HIDE-MEASURING MACHINE

As uppers leather comes into the factory it has the irregular outlines of a hide or skin, as indented as the coast of Maine, and by hand could be measured only by a master of trigonometry, through a long process of calculations, but a machine



Photograph by Leon H. Abdalian

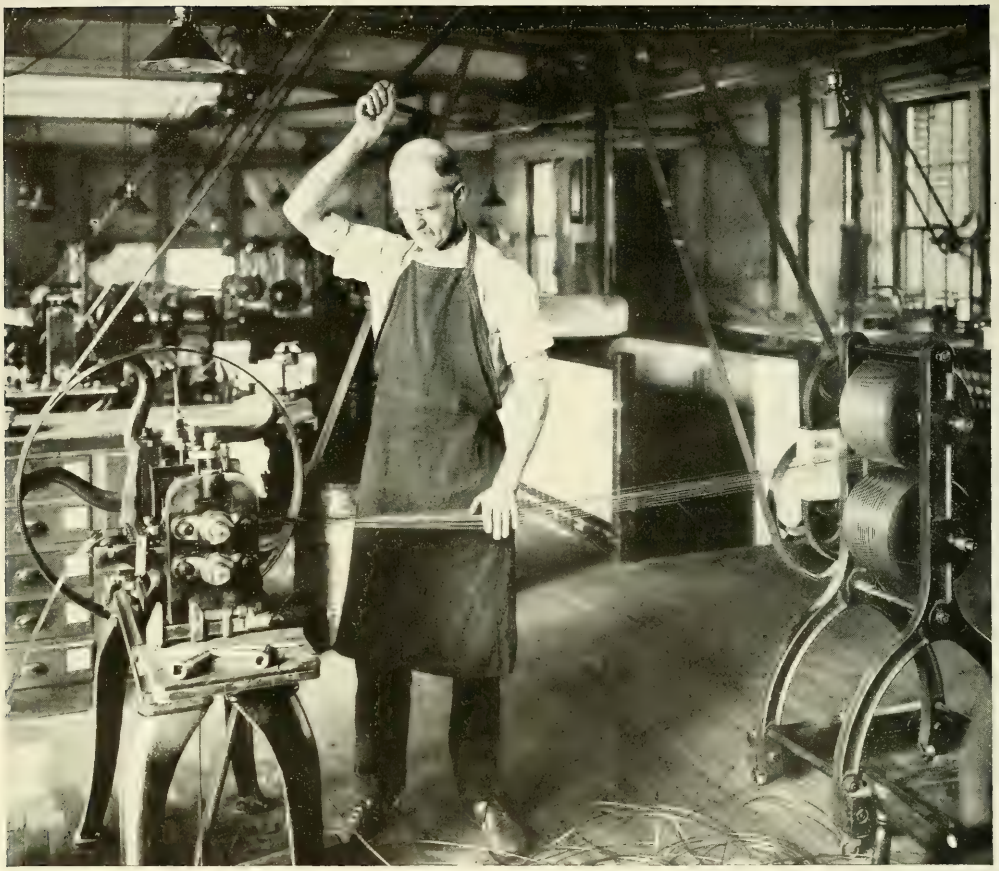
WHERE "UPPERS" MEET AND ARE JOINED TO THEIR "SOLE-MATES" IN A SHOE FACTORY

If all the American people wore hand-made shoes, as they did in Washington's time, at least two million men would be required to keep the nation shod.

has been invented that can calculate more areas in half a minute than a mathematician could in half a day. The hide or skin is fed through this device as cloth through a clothes-wringer, and a hand on a dial above points to the number of square feet in it, just as the hand on a catch-penny weighing-machine points to the number of pounds the person on the platform weighs.

"How much leather does this skin contain?" queries the operator, in effect. "Zip, zip, zip," it answers, as its pointer turns to 9.9 feet. Saying "Jack Robinson" takes longer than measuring a hide in this factory. The machine is so delicate that it has to be adjusted to temperature every day.

It would be tedious to note every person engaged, every machine, and every process in the making of a pair of shoes, for that would introduce fifty machines, a



Photograph from Waltham Watch Company

CUTTING MAINSPRINGS IN A MASSACHUSETTS WATCH FACTORY

A single Massachusetts factory makes fourteen tons of these tiny springs a year. The variation of even 1/500 of an inch in the thickness of the mainspring will affect the time-keeping qualities of a good watch.

hundred people, and two hundred processes, and serve to confuse the most patient reader, so only the salient features of the shoe's journey through the factory will claim attention.

In the linings department are big machines that cut uppers cloth, twenty to forty thicknesses at a clip, as easily as a cake-cutter cuts dough.

Beyond is the uppers leather department. Here a trained man, with stubby bladed, razor-edge knife, takes the skin, lays it on his cutting board, and, running his knife around his several aluminum patterns, cuts out vamp and quarter and toe piece with accomplished art in getting the maximum of pieces out of the minimum of skins. When he has finished with a skin it looks like shapeless strings bordering a series of irregular holes.

In cheaper grades of shoes the leather also is cut by "dinking" machines—mechanical cake-cutters applied to shoemaking. Only one ply is cut at a time, but there are series of dies for the different parts.

After the quarters, vamps, toe caps, etc., have been cut the leather must be "skived," so as to prevent any raw edges showing in the finished shoe. The edges are fed through a machine that shaves the unfinished side down to a bevel. This is then covered with cement and the thin edges folded over, much as a seamstress lays a hem.

There are some twenty-odd parts in

Photograph by Leon H. Abdalian

REPAIRING BALANCE-WHEELS IN A MASSACHUSETTS WATCH FACTORY

The balance-wheel must divide time correctly, to the infinitesimal fraction of a second. It plies back and forth nearly half a million times a day. To make one of these wheels requires some six hundred detailed operations.

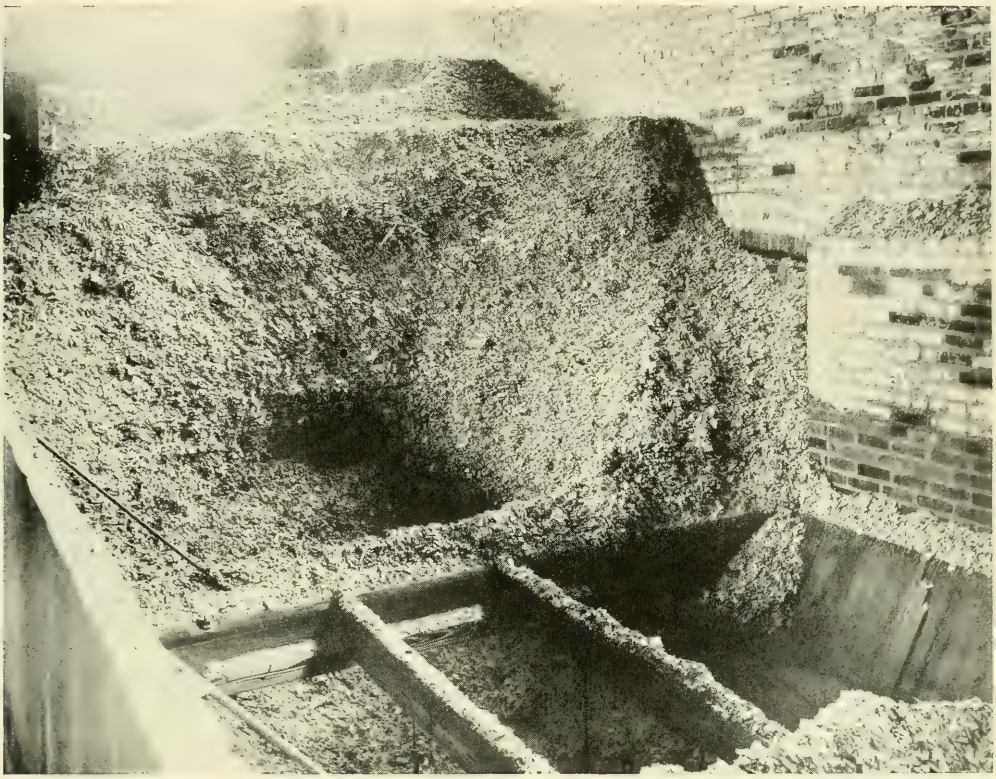
the upper of a button shoe and more in a lace shoe. To have each bit of lining and each piece of leather meet its respective seam-fellow and counterpart, at the proper moment, in the stitching department, is a task for the organizer.

The linings go from the assembly room to be transformed from individual pieces into the canvas counterpart of the leather upper. The quarters are joined at the back and stayed with a reinforcement. The vamps are cemented into shape ready for inclusion in the finished upper.

The tips go to the toe-cap room, where they are perforated at the edge to give them a pleasing appearance on the foot of the wearer. Fourteen different processes are required to transform a piece of tip leather into a finished cap, with

RAW MATERIAL FOR THE GEOGRAPHIC MAGAZINE

The mills of the Champion-International Company which make paper on which the NATIONAL GEOGRAPHIC MAGAZINE is printed are located in Lawrence, Mass. This picture shows great piles of pulp-wood ready for conversion into paper for THE GEOGRAPHIC. Parts of these wood piles are more than 50 feet high. The cars shown in the picture are on a trestle 21 feet high. The GEOGRAPHIC magazines mailed in a single year, if laid side by side, would reach from Quito, Ecuador, across Colombia and the Caribbean, thence across the United States and Canada, through the North Pole, and across Siberia, China, and Siam to Bangkok. It takes 33,000 miles of wrappers to mail one year's edition. It would require a bookshelf more than three and a half miles long to hold all the copies of this month's issue of THE GEOGRAPHIC.



GEOGRAPHIC PAPER MATERIAL READY FOR CONVERSION INTO PULP

The wood from which THE GEOGRAPHIC paper is made is first converted into chips. It is then put into huge steel digesters, where, with the use of chemicals and under a high steam pressure, it is converted into pulp, much as the juices of the stomach digest food. The digesters are directly under these bins, and are filled by pulling a slide at the bottom of the bins. Both acids and alkalis are used in converting wood into pulp. In general practice, sulphurous acid is used in treating the long-leaf, coniferous woods, having the longer fibers, such as spruce, hemlock, and fir, and caustic soda in treating the broad-leaf woods, such as poplar and chestnut, having the shorter fibers.

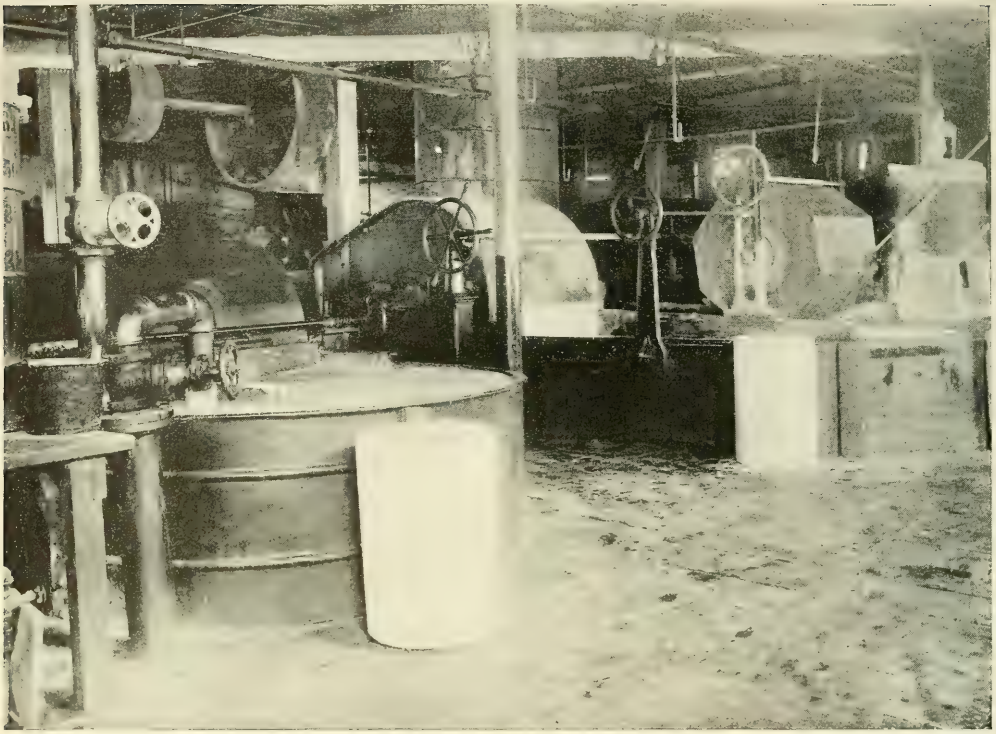
its box to hold the shape of the shoe and canvas lining to protect the hose of the wearer.

It is interesting to pause in the buttonhole department and there watch a machine cutting and working buttonholes in one operation, and another putting the eyelets and hooks in a shoe more quickly than one can tell about it.

The next step in the journey is that of joining the quarters and vamp. This must be done with great care, so that there is neither unevenness nor roughness. It is the most difficult task in the making of the upper of a shoe. Judgment and care are required and much strength of hand. Other minor processes follow, and presently the finished upper fares forth to meet its sole-mate in the making department. Before it goes, if it be a laced upper, a girl puts it through a machine that laces it up and ties it in the twinkling of an eye—a machine that would be a glorious aid to a fat man.

JOINING THE UPPER TO THE SOLE

Preparatory to its alliance with the sole, the upper is lasted. The insole has been tacked on the last, and the upper is now pulled tightly over the last with a machine that has pincers which act like human fingers. They draw the whole upper in tightly over the last, so that there is not a wrinkle left, and tack it down on the bottom. The toe and heel



A CORNER OF THE BEATER-ROOM, WHERE THE DIGESTED WOOD IS FURTHER TREATED BEFORE BECOMING READY FOR CONVERSION INTO PAPER

In this room digested spruce wood, treated with sulphur fumes, and digested poplar wood, treated with caustic soda, are mixed—the one to give strength and the other bulk to the paper, long-fibered wood making strong paper just as long-staple cotton makes strong cloth. Clay, used for filler, and other materials are then added, and the mass is thoroughly beaten and mixed and brought to a proper consistency for use in the paper-making machines.

require a little extra attention and are held down by a piece of fine wire.

The lasted shoe next goes through a trimming machine that removes all surplus leather, while a mechanical hammer pounds the leather smooth. Then it goes to another machine, where the toes and heels are beaten smooth, making the shoe ready for welting.

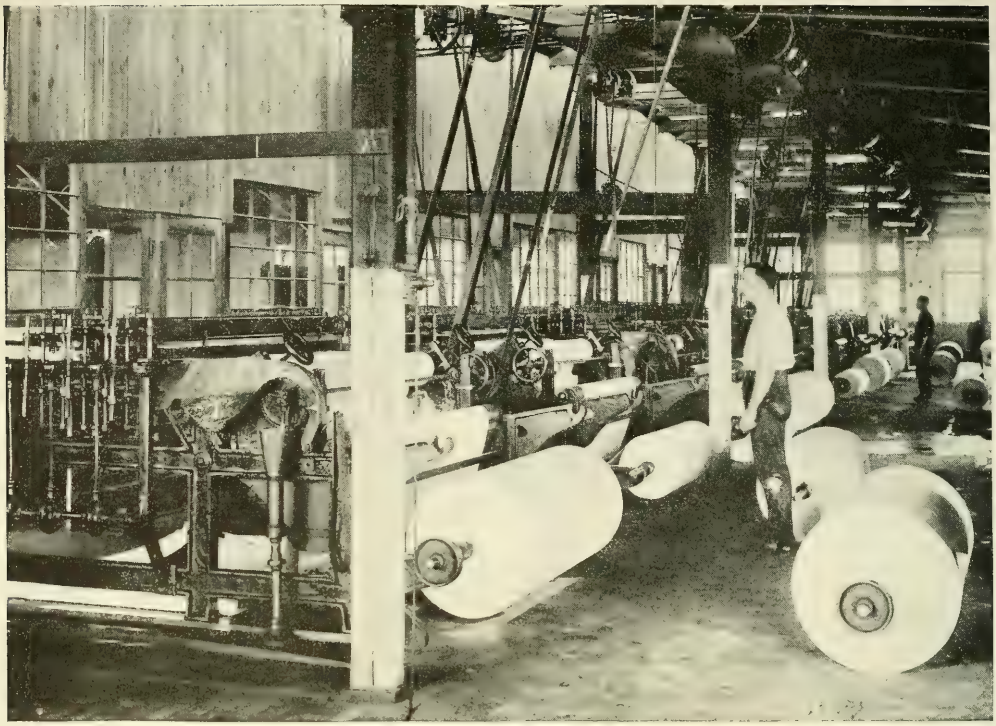
The welt is so prepared that it can be sewed to the insole and the upper in one sewing, and later have the outsole sewed to it. After the joining of insole and upper to the welt, the shoe is passed through the inseam trimming-machine. Next it goes to a machine where a small hammer gives the welt a terrific beating. The insole and welt are then covered with rubber cement, as is the waiting sole. When this has dried slightly, the sole is laid on and the shoe is put into a pressing-machine, where the cement dries.

Next it goes to the rough rounding-machine, which rounds sole and welt, allowing them to extend out from the upper at all points. Looking at the shoe on your foot, you will see that this extension is less at the shank than at the ball, and less on the outer side than on the inner side of the foot. The rough rounding-machine also cuts a little groove around the bottom of the sole for the purpose of receiving and covering the stitching, to follow. The welt extends back only to the heel. The latter has no welt, but is stitched directly and has its own special treatment.

One could write much more, telling of the preparation of the soles; how they are rolled under tremendous pressure to

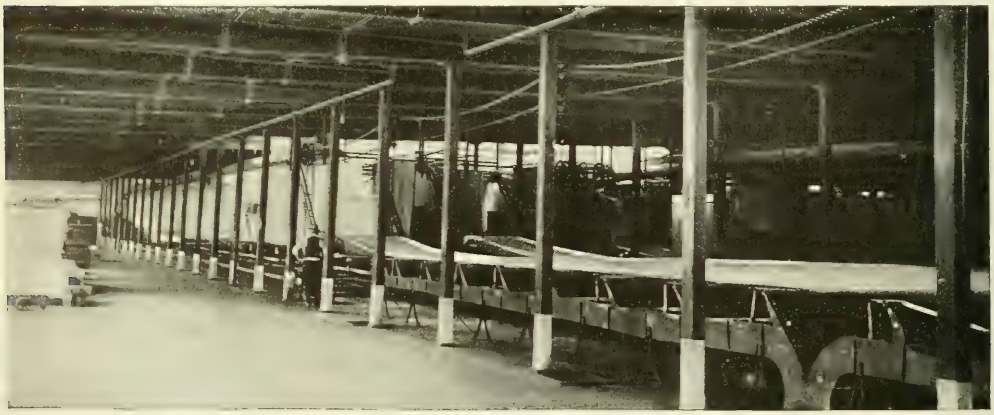
NATIONAL GEOGRAPHIC PAPER IN THE MAKING

In this large room, some two hundred feet long, the liquid pulp shown in the previous picture is converted into uncoated paper. At the rear of each machine is a tank of the pulp. A film of this pulp flows out upon an endless belt of fine-meshed wire, which is shaken vigorously. The water drops through the wire and gradually the residue solidifies. By the time the endless belt reaches the returning point, this residue is solid enough to hold its form as paper. It is then caught up between two rolls, which squeeze out the remaining water. Thence it passes around a series of iron drums filled with live steam; these dry it. After that it passes between big calender rolls and emerges in the foreground as machine-finish paper, ready for the coating or glazing process. These machines give one an idea of the huge proportions of a modern paper plant.



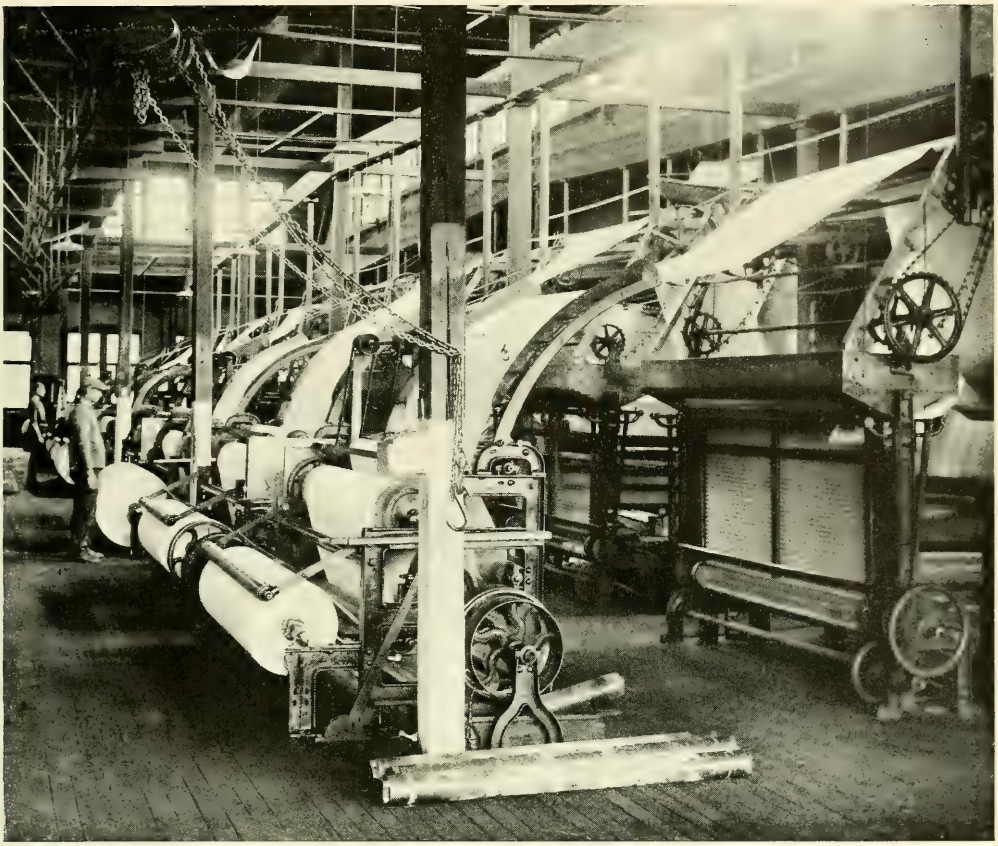
IN THE COATING-ROOM

This picture shows the rolls of paper made on the machine shown on page 237, just starting on the coating-machines. The paper passes through a bath of coating material; then through felt-covered rolls; then between vibrating brushes, which lay the coating material evenly and smoothly on the paper. It then passes out at the left into the drying-room (see following illustration).



THE DRYING-ROOM IN THE COATING MILL AT LAWRENCE, MASS.

After the paper has received its coating from the coating-machine shown in the previous picture, it passes in a continuous web to the drying-room. Blasts of hot air coming out of galvanized ducts beneath support it for a distance of 100 feet, until it reaches the drying-chamber in the rear of the room. Here it hangs in festoons much like those of cotton cloth shown on page 219. In the picture the paper is passing from right to left. After leaving the drying-room it is wound on rolls, as shown in the next picture.



PAPER READY FOR THE CALENDER PRESSES

This picture shows the paper after it has been coated and dried, as shown on page 238, and is being rolled at the end of the coating-machine. It is now ready to be sent to the big presses which calender it (or iron it, as popular parlance would have it). The pictures on pages 238 and 239 show a continuous process over a single machine; but, on account of the length of the machine, the process is illustrated in sections.

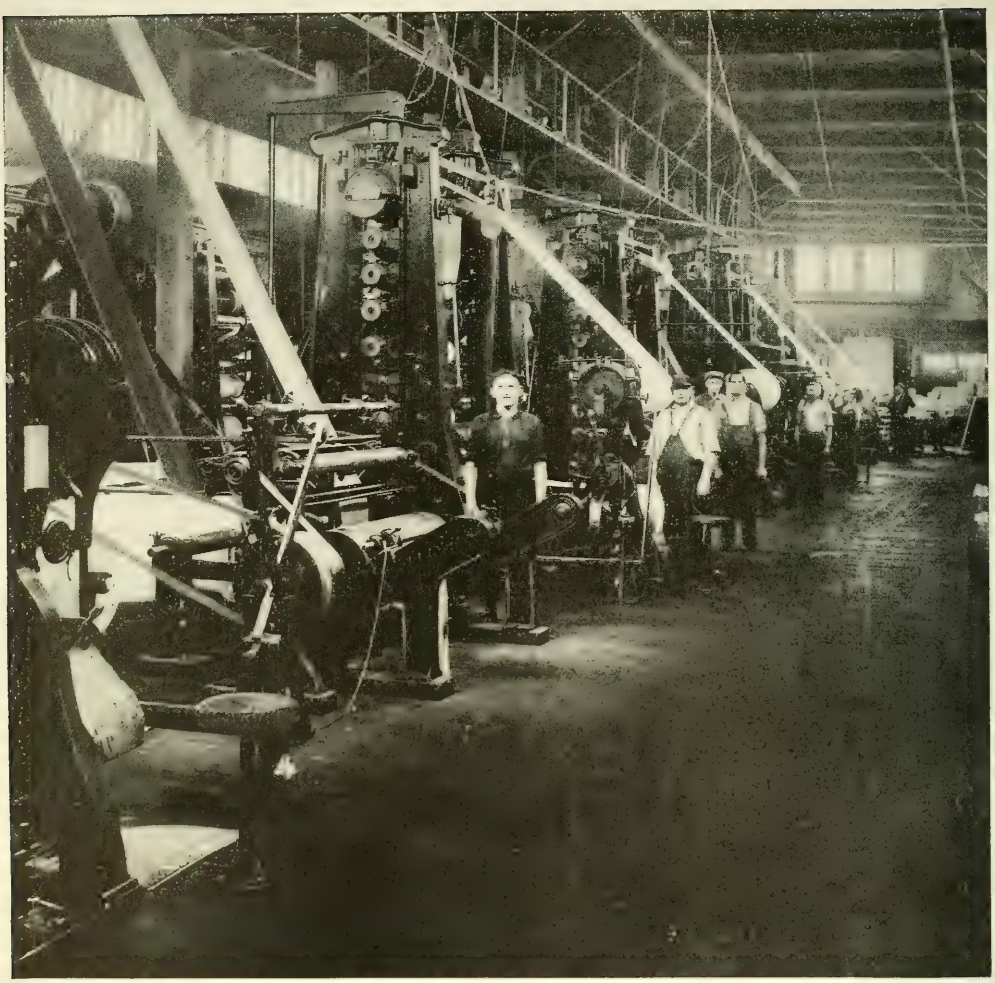
solidify the leather, just as the village cobbler beats them under his wide-faced hammer; or of the heeling-machine, that sets the heel in place and drives all of the nails at one operation; or of the counter-making machines, that give stiffness to the spur piece of the heel.

One shoe factory in Massachusetts has a daily output of 14,000 pairs, each pair marching through the factory in fourteen days in ordinary times.

THE PECULIAR LANGUAGE OF THE SHOE FACTORY

The industry has its own peculiar parlance. A "cripple girl" is not crippled at all. Rather she looks after the "cripples," as defective parts of a shoe are known. "Vamping" has nothing whatever to do with the activities of sirens, but is only the process of joining the vamps and quarters to the shoe. "Blackball" doesn't relate to club proceedings, but rather to a mixture of grease and lampblack for blacking the edges of shoe soles. A "cack" is an infant's shoe, and a "pac" a duplicate of an Indian moccasin. An "iron" is a unit of thickness in sole leather, and a "lift" is one thickness of leather in the heel. A "nullifier" is a shoe for house wear, having a high vamp and quarter, dropping low at the sides, with a short rubber goring.

It would be idle to attempt in a few paragraphs to describe the hundreds of processes and the scores of intricate



A BATTERY OF CALENDER PRESSES AT WORK FINISHING MAGAZINE PAPER

After the coated paper has been dried and put into rolls, as shown in the preceding pictures, it is brought to the room shown here. A roll is put in the reel at the man's shoulder in the foreground and started through the machine. It passes between the two top rollers, and then in and out between the succeeding rollers, until it reaches the bottom. Many tons' pressure have ironed it before it comes out and is rolled up again. This process gives it the finish that the NATIONAL GEOGRAPHIC must have to maintain its high standard.

machines employed in the making of watches; but to visit a great Massachusetts watch factory and there to see some of the operations of making a good timepiece is to behold the highest development in mechanical accuracy and quantity production.

STEEL HAIRSPRINGS WORTH $49,000 A POUND

Here one sees alloy steel wire worth five dollars a pound being converted into hairsprings, some so delicate that they are worth $49,000 a pound. There a machine is taking in steel wire and turning out microscopic screws with perfect heads and threads and slots, yet so small that the ordinary eye wants a magnifying glass to perceive that they are aught but specks of steel. In another place is a machine which transforms bare blanks into completely bored movement plates without the interposition of a human hand.

THE ASSORTING-ROOM IN THE PAPER MILL

After the paper has been calendered, the big rolls are put into a cutting-machine that cuts the continuous roll into sheets of the desired size. These are then examined, sheet by sheet, by the women shown in the picture. All perfect sheets are put into one pile and the imperfect ones are placed in another pile. The perfect sheets are then ready, after trimming, for the presses of the NATIONAL GEOGRAPHIC.

To see a skilled hairspring-maker take three little pieces of flat wire and coil them together with the aid of a pencil-like rod slotted at the end, putting the coil into a tiny copper case just large enough for the reception of the untempered spring, looks so easy that one thinks that anybody could do it; but on the day that a GEOGRAPHIC representative was studying the factory in question the foreman of the department in charge of hairsprings said to the secretary of the establishment, "I took two new girls on yesterday. One of them got one spring wound yesterday and one today, but the other has not succeeded in getting a single spring into the tempering box." Yet so skilled do the women spring-winders become that an expert can finish one every few minutes.

There are three slots in the end of the winder. Into one of these goes the alloy steel wire that is to constitute the hairspring. Into the others go soft steel wires of corresponding dimensions. Between the steel wires is sandwiched the one of alloy.

The little copper boxes are then sent to the annealing furnace and heat-treated. When this process is finished the soft wires are thrown away, leaving the alloy wire a perfectly wrought hairspring, the price of the smallest of which is seven dollars a dozen, or more than a hundred times their weight in gold.

SCREWS SO SMALL THAT 50,000 MAKE A THIMBLEFUL

But, tiny as they are, these infinitesimal springs must impart to the balance-wheels of the watches they regulate 432,000 impulses a day, and must measure time correctly, down to an astonishingly small fraction.

The machine that makes the tiny watch screw is a marvel of mechanism. In the morning it is given a long steel rod of small diameter, and is then left to its own resources. Now a tiny section is turned into the shape of a finished screw; then the thread is cut; next the slot is cut in the head, and finally a mechanical hand deposits it in a bath of oil, where it stays until fished out with a tiny steel net like a tea-strainer. A sharp eye is required to recognize it as a screw. It would take 50,000 of them to make a thimbleful.

A WIZARD OF MACHINERY

The most dramatic machine in this veritable maze of intricate and wonder-working mechanisms is that which makes the lower movement plates.

On one side is a magnified dime savings bank, mounted so that the "blanks" it contains will present themselves one by one at the bottom. A mechanical hand reaches over, and, taking one of these blanks, gives it to the first part of the mechanism, which grasps the blank and bores several holes. Then another mechanical hand takes the blank and presents it to the second section, which does its "stint" in the process of plate-making. A third hand next takes the blank and presents it to the third section of the machine, which contributes its share in the conversion. These three operations finish one side of the plate.

Thereupon comes a fourth hand and passes the plate to a fourth part of the mechanism; but in doing so it turns the plate over and presents the unfinished part to the drills. A fifth hand, a sixth, and a seventh pass the plate on to the several remaining sections of the machine, and a final presents it, completed, to the reservoir beyond.

One hundred and forty-one operations on one little disk of metal, all without the aid of a human hand and each performed with an accuracy of a fraction of an inch that reaches to the fourth decimal place!

A CITY FAMOUS FOR ITS JEWELRY

One who wanders around the Bay State looking for startling applications of machinery to the making of articles useful and ornamental will find things that amaze in almost every town.

Think of ten thousand different kinds of watch-chain links produced in a single establishment! Or of a machine that converts gold wire into watch chain by the hour without let or hindrance from any man! Such machines are busy throughout the year in Attleboro.

Rolled jewelry is finding a tremendous sale all over the world, and the Attleboro factories are months behind in filling their orders.

In one plant the first step in making a filled watch chain is to prepare an ingot of copper and zinc alloy about a foot long and an inch and a half in diameter. Over this is put a sleeve of, say, 14-carat gold, cast to a perfect fit. This gold-filled ingot is then put into a machine which hammers it, reducing its diameter and increasing its length. The process is repeated by other machines until finally it becomes small enough to be drawn through dies as wire, each time growing thinner and longer until it has the diameter of the wire in the chain link.

From this stage the wire may be fashioned into links and chains either by hand or by machinery. In the latter case the wire is automatically fed into the chain machine. A small knife comes out and cuts off the length required to form a link. Two little jaws close and the bit of wire becomes the shape of a capital U. Then a tiny hammer taps the open U in such a way that it becomes an O, which, with another movement, has its position switched from horizontal to upright. Then the wire is fed through the finished link and the process repeated, the chain growing longer at the rate of many feet an hour.

MASSACHUSETTS MAKES EVERYTHING, FROM SUSPENDERS TO SILVERWARE

There are many lines of manufacture in which Massachusetts is the nation's leader other than those already noted. The State makes seven-eighths of the nation's whips; more than two-fifths of its gum shoes, rubber boots, and linen goods; one-third of its leather belting, bicycles, and motorcycles; a fourth of its envelopes, fireworks, silverware, sporting and athletic goods, stationery, suspenders

Photograph by Herbert B. Turner

DRYING SAILS AFTER THE STORM: GLOUCESTER, MASS.

One gets a vivid idea of the wealth of the sea at Gloucester. Cod and mackerel, haddock, herring, and halibut; tautog and quahog; scup and sculpin; swordfish and spikefish; tinkers, cusk, and eels; blue fish and butterfish; flounder, perch, and sea trout; oysters, lobsters, and clams—one must tax his fishing lore to enumerate the species that are brought into port daily.

and garters; and in all these lines surpasses every other State.

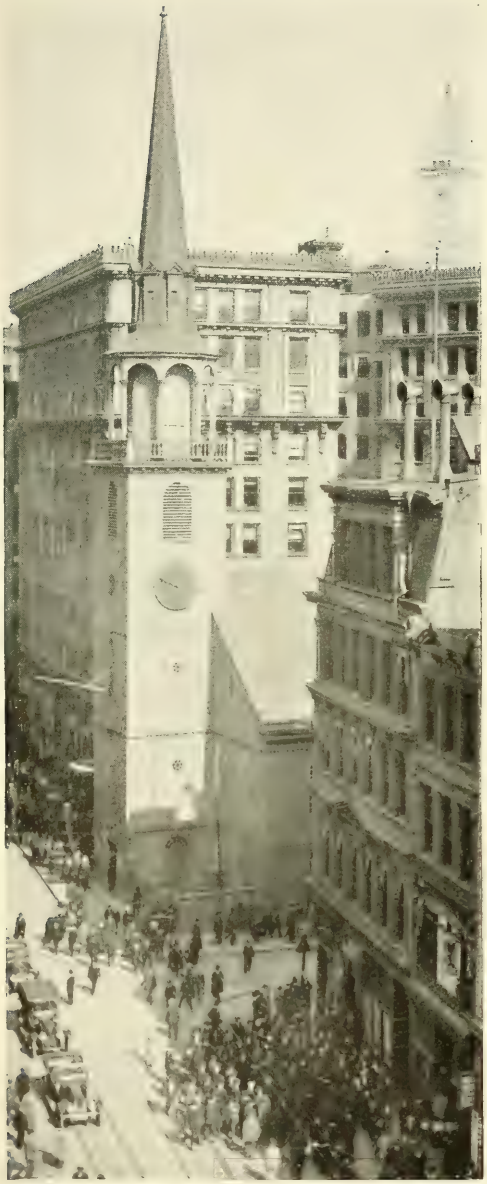
With such a vast concentration of light manufactures, it is only natural that Massachusetts should have many cities and towns; but one is hardly prepared to believe that this small Commonwealth has 32 cities of 20,000 population and upward, more than any other State of the Union. More than 100 of its smaller municipalities have populations above the 5,000 mark.

"THE HEART OF THE COMMONWEALTH"

About each of the principal cities a word must suffice. As Boston will later be described in the "Big City" series of articles appearing from time to time in THE GEOGRAPHIC, no mention of it need be made here.

The second city of the State is Worcester, which calls itself the "Heart of the Commonwealth." A busy metropolis, it has been a cradle of invention and is a center of industry. Within a radius of fifteen miles of its central square were born Eli Whitney, whose gin made cotton the fabric of civilization; Ichabod Washburn, who drew the first piano wire in America; Erastus Bigelow, the inventor of the carpet machine; Thomas Blanchard, who designed a machine for making tacks and a lathe for turning irregular shapes; George Crompton, the inventor of the power loom for weaving fancy cottons; and Asa Hapgood, inventor of the upper berth in sleeping cars.

Worcester has drawn enough wire to girdle the globe a thousand times. It has made enough corsets to fit out every feminine form on the earth. It has facilities for producing enough envelopes to carry



Photograph by Leon H. Abdalian

IN THE SHADOW OF THE OLD SOUTH CHURCH, BOSTON

Erected in 1729, Old South Church has lived through the vicissitudes of war and peace for nearly two centuries. Diagonally across the street from it, Benjamin Franklin was born. Within its walls were held many of the town meetings that crystallized the purposes of the colonists to be free. Not many years ago commerce would have razed its walls and reared on its site an office building. But the people of Boston raised $400,000 to keep it as a shrine of our national beginnings.

the correspondence of the world. It has the largest belt factory, the largest loom works, the largest grindstone plant, and the largest automobile crank-shaft forging plant in existence.

AMERICA'S FOREMOST MILL TOWN

Fall River, third in population among the cities of Massachusetts, is America's foremost "mill town." It has 148 textile mills and employs 40,000 operatives. That it can bring coal for power from Pennsylvania and cotton from the South, paying the high freight rates, and still compete with the South in the manufacture of cotton goods is a proof of its energy and efficient organization. Every day the city weaves enough cloth a yard wide to reach from New York to Panama. It produces more goods than any State in the Union except its own.

A close competitor of Fall River is New Bedford, making fewer yards of cloth than its rival, but specializing in finer grades, which it produces at the rate of a mile a minute. New Bedford has a twentieth-century prosperity based on cotton as great as that in the seventeenth century based on the whaling industry.

AMERICA'S CAPITAL OF EDUCATION

Cambridge is so nearly part and parcel of the New England metropolis that it seems to have lost its identity in almost every way except legally. When one is reminded that this city, with its population of 113,000, is without a daily newspaper, or a good hotel, or a modern theater, one can readily see that its identity, except for purposes of taxation and local law, has been thoroughly welded into that of Boston.

But in education it can almost claim to be the nation's capital. With Harvard and Radcliffe and Technology, its influence reaches wherever religion, philosophy, science, and engineering extend.

But Cambridge is more than a university town. It is one of the principal manufacturing centers of the Commonwealth.

"THE WORKSHOP OF THE WORLD"

Lowell proudly calls itself the "workshop of the world." It is a busy town,

possessing the world's largest hosiery and underwear mills, as well as its most extensive sail-cloth factory, upper shoe-leather tannery, cash-carrier and pneumatic-tube factories. It also has what is considered the highest type of textile school to be found anywhere.

SPRINGFIELD, LYNN, AND LAWRENCE, A THRIVING TRIO

Admirably situated in the Connecticut Valley, at the cross-roads of east and west and north and south trade, Springfield is a thriving municipality, its industries alive to the possibilities of the future, and its civic spirit a contagion that infects resident and visitor alike. The city claims that its municipal buildings constitute the finest civic group in the United States. In one of these buildings is an auditorium with a seating capacity of 4,500.

Lynn and Lawrence are such close rivals in point of population that it will require this year's census to decide their relative rank. Lynn is the woman's shoe capital of the world, and Lawrence is a great mill town, with textiles and paper its principal products. It is at Lawrence that the paper for THE GEOGRAPHIC MAGAZINE is manufactured (see pictures, pages 234-241).

CITIES FAMOUS FOR MEN'S SHOES, GUM SHOES, AND SLIPPERS

Following in order of population are Somerville, part and parcel of the Boston community, but still as independent of the Hub, governmentally speaking, as if it were at the other end of the State; Brockton, where men's shoes are produced by the millions of pairs; Holyoke, where the Connecticut River surrenders its power at Hadley Falls for paper mills, silk factories, and similar industries operated by water power at only a fifth the cost of steam power; Malden, the "gum-shoe" city; Salem, once the witch city, but now a staid and solid commercial community; Haverhill, the "slipper city"; Chelsea, industrial borough of Boston; and Newton.

Fitchburg brings up the rear of the line of cities with 40,000 population and upward. It reminds the world that it makes three revolvers a minute, five pairs of shoes, four cans of axle grease, three shirts, eight miles of yarn, ten paper boxes, fifty paper bags, fifteen pounds of brass, and other things in proportion.

One passes by with regret a hundred other splendid cities and towns, for in their history, their achievements, and their beauty each of them challenges attention.

Likewise Plymouth Rock and Provincetown, Lexington and Concord, and a score of such places are shrines that live in the hearts of all Americans.

MASSACHUSETTS' PARKS AND FOREST RESERVATIONS

In the establishment of public parks Massachusetts has displayed the same appreciation of esthetic and humanitarian values that has characterized her in other fields. Greylock, the State's highest peak, has been set aside for the public, a reservation of 9,000 acres around its summit having been created.

Mount Tom, which rises like a sentinel lookout guarding the cities of Northampton, Holyoke, and Springfield, is another place under State jurisdiction where one may go and commune with nature.

A number of State forests have also been established. One in Plymouth County, covering 7,000 acres, is appropriately named the Miles Standish State Forest. Another, in the vicinity of Andover, contains 1,200 acres, while a third, in the vicinity of Winchendon, contains 1,700 acres. There are two in the Berkshire Hills aggregating 2,200 acres. The most modern forestry methods are practiced in these areas, and the State is striving energetically to remedy the loss of her timber at the hands of an unrestrained commercialism in bygone decades.

In her verdict of November 4, 1919, Massachusetts earned the gratitude of the country and showed that the spirit that founded the greatest republic and won a world to liberty still survives and stands committed to law and order. No praise is too high for this new declaration against class tyranny, this new stand for the ideals that have always made Massachusetts great.

TÊK PAI IS THE NAME GIVEN THIS BAMBOO RAFT IN FORMOSA

The craft is characteristically Formosan. Although there is a type of bamboo raft found along the China coast, it is not nearly so large as that of Formosa, since the bamboos on the mainland cannot compare in size with those growing on this island. There is a round wooden tub in the center for luggage, and when the sea is rough the passengers sit in it, too.

FORMOSA THE BEAUTIFUL

By Alice Ballantine Kirjassoff

Illustrated with photographs by the official photographer of the Government of Taiwan and from the Chief of the Camphor Department

"ILHA FORMOSA," beautiful isle, early Portuguese voyagers called the island now owned by Japan and known to them as Taiwan. The Portuguese name has clung to it in all European countries, and never was a more appropriate name given to an isle of the sea.

If you care to confirm this in one of several pleasant ways, sail along the west coast of Formosa in a têk pai (or bamboo raft, see page 246) on a clear day, and you will witness a pageant of mountain scenery that will haunt the memory for many a day.

Beyond the fertile plain, with its emerald paddy-fields and its picturesque little villages dotted here and there on the banks of meandering streams, foothills with unending variations of contour silhouette their tree-fringed summits against the paler screen of more distant mountains. Of these, sometimes five and sometimes even six parallel ranges are visible at once, each a separate ribbon of color, shading from the deepest sapphire to the palest azure and extending in an unbroken chain of beauty from north to south.

On the east of the island you can see the highest coastal cliffs known, at some places rising abruptly to an elevation of about 6,000 feet, and affording an impregnable wall of defense to the wild aboriginal tribes living in the mountains back of them.

AN ISLAND OF AMAZING VARIETY OF VEGETATION

Formosan scenery is unusual in its diversity of vegetation within such narrow confines—the greatest length of the island from north to south is about 264 miles and 80 miles is its greatest width.

From the palms and tropical fruit-trees of the western plain it is only a short step to the slopes of the lower mountains, with their exuberant jungles of various growths—the bearded banyans, the graceful tree-ferns, which in sheltered nooks attain the height of palms, and the ubiquitous bamboo grass.

Here, among moss-strung trees, is found growing the beautiful butterfly orchid, while in exposed spaces, nestling among the rocks, rose-pink azaleas flaunt their gay blooms. A little higher are plateaus covered with camphor laurel, the largest tracts of these valuable trees in the world, while still higher grow the forests of coniferous trees — the giant benihi, similar to the redwoods of California, the largest trees in the East and the second largest in the world; the valuable hinoki, or Japanese cypress, and the pine, cedar, and spruce of the New England States; and higher yet the craggy peaks of the tallest mountains, but sparsely covered with vegetation of any sort, where eagles build their nests, and which for the greater part of the year lie beneath a mantle of snow.

"THE SECOND WETTEST PORT IN THE WORLD"

The usual approach to the island is the port of Kelung, in the extreme north. It was here that the author of this paper landed after a four days' steamer journey from Kobe. The rain was coming down in sheets, obscuring the hill-crested harbor, and all looked gloomy except for one bright patch of sky, where the sun was struggling to come through.

I remember reading in my old grammar-school geography that Kelung is the second wettest port in the world, and I have no trouble in believing it. I have been there many times, and each time it has rained. Without showers, Kelung would wear an unrecognizable face, like a person without spectacles who was accustomed to wearing them.

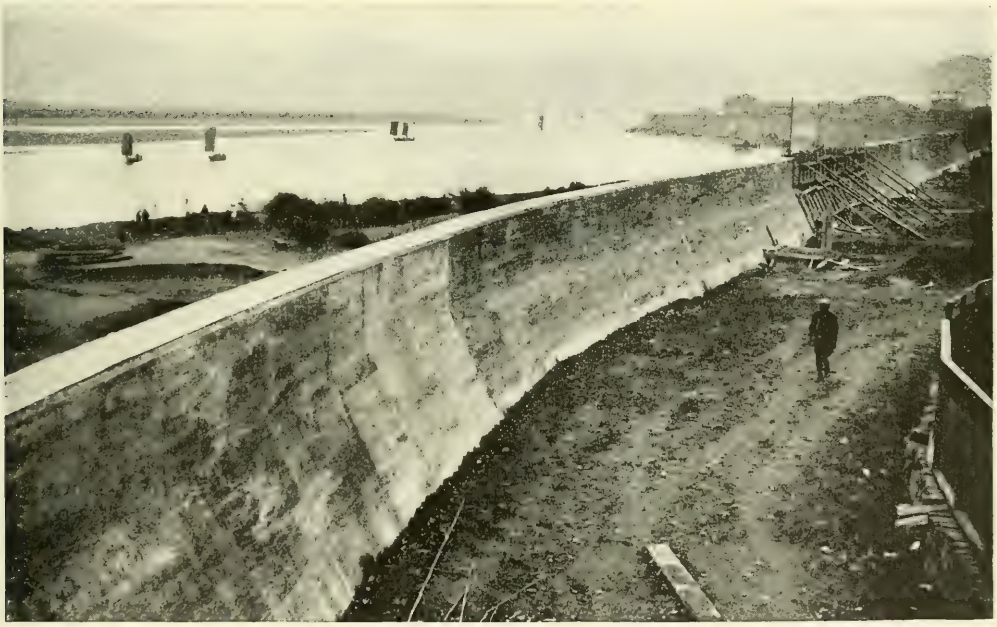
After disposing of the numerous porters who escorted me from the steamer,

SAMPANS NEARING THE BUND: TAIHOKU, FORMOSA

DAITOTEI IS UNNATURALLY CLEAN FOR A CHINESE CITY

Formerly Manka, Daitotei, and Taihoku proper (within the castle walls) were three independent cities, but with the establishment of the Governor General's Office in the castle and the principal administration offices around it, the three sections became amalgamated into Taihoku. Daitotei is the Chinese section of Formosa's busy capital.

THIS IS NOT CHINATOWN IN VENICE; ONLY A STREET SCENE IN THE CHINESE QUARTER OF TAIHOKU AFTER A TYPHOON



VIEW OF THE DAITOTEI BUND SHOWING THE TYPHOON WALL: TAKEN FROM THE EXTREME SOUTHERN END OF TAIHOKU

Formosa is frequently swept by violent storms, the sea immediately to the south of the island being known as the "birthplace" of typhoons. In an easterly storm which visited Taihoku 22 years ago the wind attained a velocity of 97 miles an hour.

TEA-PICKING GIRLS IN DAITOTEI: FORMOSA

"Seated on low stools before wide wicker trays, these bright-eyed maids in their peacock-blue smocks, their front hair clipped in bangs, and with a gay posy or two stuck in the braided knots at the backs of their necks, were in animated contrast to their rather drab surroundings."

COOLIES PACKING OOLONG TEA

Nine-tenths of Formosa's Oolong tea finds its way to the United States. It is shipped in lead-lined boxes to protect the sensitive leaves from the salt air of the sea voyage and from contamination with the odors of other freight. Even this precaution cannot safeguard Oolong from some cargoes—copra, for example. If an Asiatic disease makes its appearance on board and the vessel is subjected to fumigation, the cargo of the tea ship is practically ruined.

A DUCK-TENDER GIVING HIS BROODS A SWIM

Formosans are extremely fond of ducks. On a walk through country districts the traveler frequently encounters a youth with a long pole acting as tender for two or three hundred, sometimes a thousand, birds which have no special feeding ground, but wander over the countryside, eating and drinking wherever they choose.

SCENE IN FORMOSA'S OPIUM MONOPOLY BUREAU: THE ROUND BALLS OF CRUDE OPIUM ARE IMPORTED FROM INDIA AND THE FLAT PARCELS COME FROM PERSIA

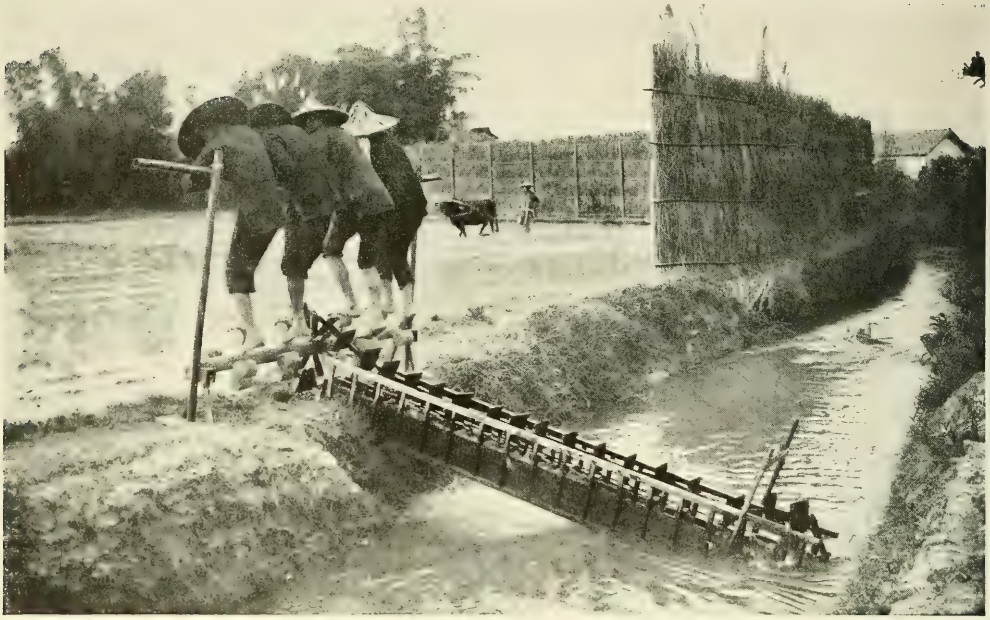
Opium smoking is controlled by license. About 2 per cent of the Chinese in Formosa are still addicted to the habit, but year by year the practice is being checked. The island has a population of more than 3,600,000, more than 92 per cent of whom are classified as "Formosans," mainly people of Chinese blood; a little more than 3 per cent are Japanese, and 3½ per cent are aborigines ("ripe" and "raw" savages; see text, page 272).

AN ORCHESTRA OF CHINESE "SING-SONG" GIRLS

This is the Formosan version of the "jazz band." The youthful musicians provide the entertainment for tea-house habitués.

A TYPICAL CHINESE HOMESTEAD IN FORMOSA—EXCEPT FOR A SOW WITH A LITTER OF PIGS!

"Here and there we passed the low, mud, thatched dwelling of some Chinese homesteader, with a pool of water by way of front yard, where huge slate-colored buffaloes were taking their noonday siesta, a goodly number of ducks and geese keeping patrol as they slept."

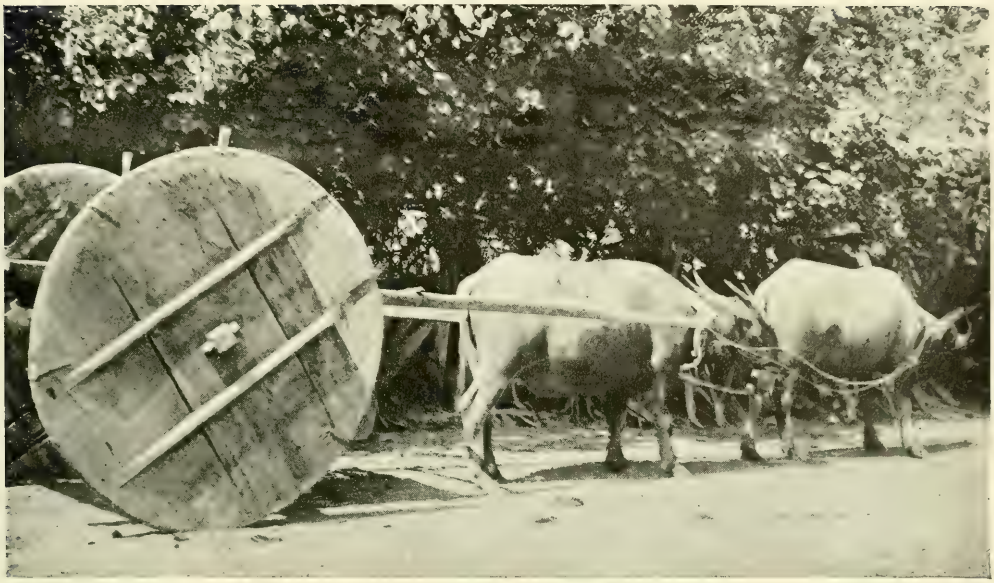


COOLIES WORKING A FOOT-PUMP AND A BUFFALO PLOWING IN THE BACKGROUND: FORMOSA

Very picturesque are these foot-pumps, worked by three and sometimes four coolies, which raise water from one field to another.

A WATER BUFFALO WITH HIS SMALL CHINESE DRIVER

No rural Formosan landscape is complete without at least one of these hulking creatures, with its threatening horns and great staring eyes. Most of the plowing on the island is done with these animals. They are strong and can endure much hard work, provided they have plenty of water, which must be poured over their backs as well as given them to drink. They may be seen on the outskirts of any large town, standing in tanks six or seven feet square while their drivers administer "shower baths."



THE TYPE OF CART USED IN THE SUGAR-CANE DISTRICTS OF FORMOSA

As the axles of the wheels are never greased, the approach of these sugar-cane-laden carts is heralded from afar by strident squeakings.

FIELDS OF FORMOSAN SUGAR-CANE

For the first time in its history, Formosa exported sugar to the United States in 1917. The other principal exports to America are Oolong tea and camphor. Although the island is world-famous for its camphor, the value of its sugar exports during one year of the World War was fourteen times greater than that of the camphor-tree product.

FRUIT-BEARERS RESTING ON THEIR WAY TO MARKET

Formosan pineapples are smaller than the Hawaiian varieties, but they make up in flavor what they lack in size. The smaller fruit are longans. From the green leaves of the pineapple the Formosans get a fiber which they convert into a cool summer cloth. The island is no less famous for its flowers than for its fruit.

LABORERS THRESHING RICE

The portable tubs constituting the Formosan's threshing apparatus look for all the world like sails, in the wake of which follow the threshers with their bundles of grain. These they rap smartly against the corrugated boards affixed to the tubs, to separate the rice from the blade.

I boarded a train for Taihoku, the capital city, which on most maps still bears its old Chinese name of Taipeh.

In about ten minutes we passed through a long tunnel, and when we came out on the other side of the mountain gap the landscape was flooded with sunshine. Rain seemed as out of place in this new world as stars in the broad daylight.

The lush green rice-fields, with the denser green hills and purpling mountain back of them, lay glancing in the sunlight with a brilliancy that contrasted sharply with objects but so recently viewed through the rain.

Here and there we passed the low, mud, thatched dwelling of some Chinese homesteader with a pool of water by way of front yard, where huge slate-colored buffaloes were taking their noonday siesta, a goodly number of ducks and geese keeping patrol as they slept, while on the brink would waddle a black sow or two, of an elongated variety, with backs that sagged in the middle, their numerous offspring following grunting at their heels.

A BENIHI TREE (*Chamæcitaris formosensis* MATS.)

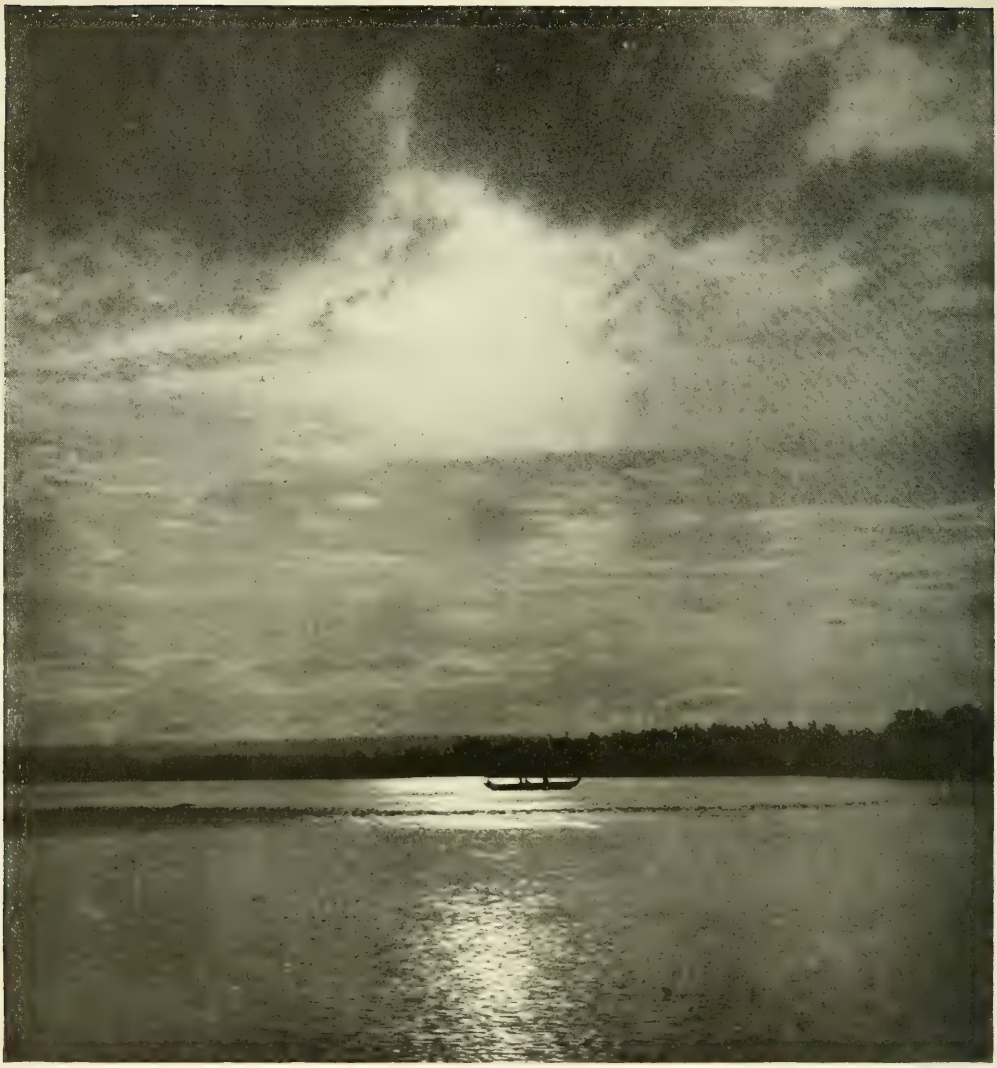
The giant benihi of Formosa, similar to the redwood of California, is the largest tree in the East and the second largest in the world.

I looked about in vain for a barn of some sort to house these creatures by night, but was told to my surprise that they were all dearly beloved members of one household and lived together most amicably under the same roof with their owner.

At length we arrived at Taihoku, covering the distance of twenty miles in a little more than an hour. I was amazed at the westernized appearance of the city—the broad streets, the beautiful parks, and the imposing public buildings.

A JAPANESE HOUSE-CLEANING TWICE A YEAR

Japanese cities, which I had so recently visited, possessed the picturesqueness of the Orient, and I had expected even more of this quality in what I had looked upon as a most out-of-the-way corner of the globe. Only the gateways of the old wall which surrounded the ancient Chinese



SUNSET FROM THE BUND, THE WATERFRONT IN DAITOTEI, THE CHINESE SECTION OF TAIHOKU, CAPITAL OF FORMOSA

At sunset dusky ghosts of sampans, laden with families living up the river, glide homeward against a jonquil sky. Taihoku, a city the size of Lowell, Mass., is situated 20 miles southeast of the port of Tamsui, at the mouth of the Tamsui River, and 18 miles southwest of Kelung, the seaport possessing the best harbor of the island (see map, page 262).

city, remain, looking as out of place in their rejuvenated setting as the Egyptian obelisk in Central Park.

I found more of the quality I had looked for in Daitotei, the Chinese section of Taihoku; but even Daitotei was unnaturally clean for a Chinese city.

The Japanese insist upon two official house-cleanings a year, and as they are executed under a policeman's vigilant eye, you may be sure that there is nothing slipshod in the undertaking. All a man's chattels, his Lares and Penates, his wives and children (I say wives advisedly, for if a Chinaman can afford it you can count on his having more than one), even to his cherished opium pipe, all are heaped unceremoniously in front of his dwelling, and the work of scouring begins.

Everything he owns is washed, within

A JUNK ON THE TAMSUI RIVER

The antique sails, patched and repatched, speed the oarsmen when sailing down-stream with the wind.

and without, except his wives and children, and this additional sanitary measure would round out a very good beginning toward that attribute which is attested as next to godliness.

MUSIC TO SAVE THE DYING FROM EVIL SPIRITS

However, in respect to noise, Daitotei is characteristically Chinese. There is never an hour of the day without some puppet show and its accompaniment of drums and cymbals, or a marriage procession, or a funeral procession, or, at best, a few bunches of fire-crackers to celebrate the birthday of some indulged urchin, the apple of his father's eye.

If any of the sounds attendant on these rites are lacking, there can always be heard the piercing music of "sing-song" girls, entertaining tea-house habitués, the far-reaching cries of push-cart vendors, the high-pitched, unintelligible chatter of the passers-by, and, at the risk of intro-

Photograph by B. Boning

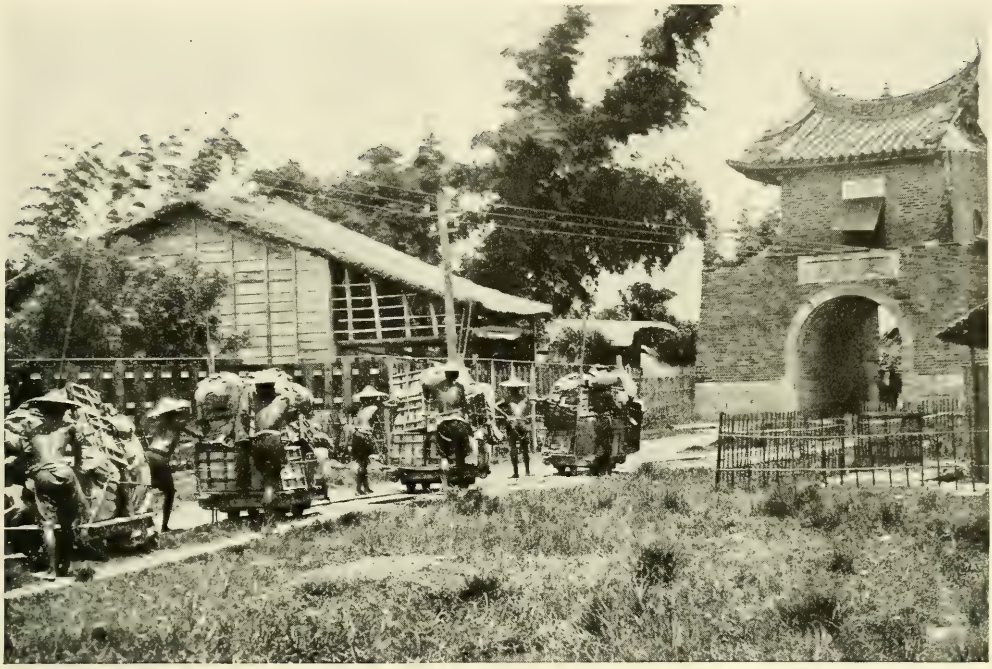
PASSENGER PUSH-CARS IN FORMOSA

ducing an anti-climax, I might add the cackle of hens; for so numerous are these denizens of the barnyard that it seems to the nervous onlooker as if some one has either just stepped on one or just avoided stepping on one.

I shall never forget my first night in Daitotei. I was tired out by an arduous day, but my determination to retire early was dealt a sudden blow by the outbreak of a Chinese orchestra in the narrow alley at the back of our house. Its irritating discordances, repeated fortissimo in rapid, monotonous succession, not only drove away all idea of sleep, but incidentally nearly drove me mad.

Our servant, upon being questioned, informed us—but not in just these words—that our next-door neighbor, a wealthy Chinese money-lender, was about to give up the ghost. After repeated objections on my part as to the advisability of accelerating his end in this violent manner, I was assured that the music was intended only to drive off such evil spirits as might be lurking about the house.

There is no doubt that the music was admirably adapted for this objective, and



PUSH-CARS BEARING IMPERIAL JAPANESE MAIL

All the baggage push-cars are third class. The passenger cars are first class and have the right of way. The third-class cars have to be derailed to allow the first-class cars to pass, although it would be far more convenient if the first-class cars were derailed, as the others are usually heavily loaded.

seeing that there was no hope of relief, I resigned myself to the rather meager consolation of playing the innocent's rôle in suffering for the guilty. However, when I was told that the Japanese have instituted a ruling whereby all music of this nature must cease at midnight, I felt a more substantial basis for thankfulness.

THE TEA-PICKING GIRLS AT WORK

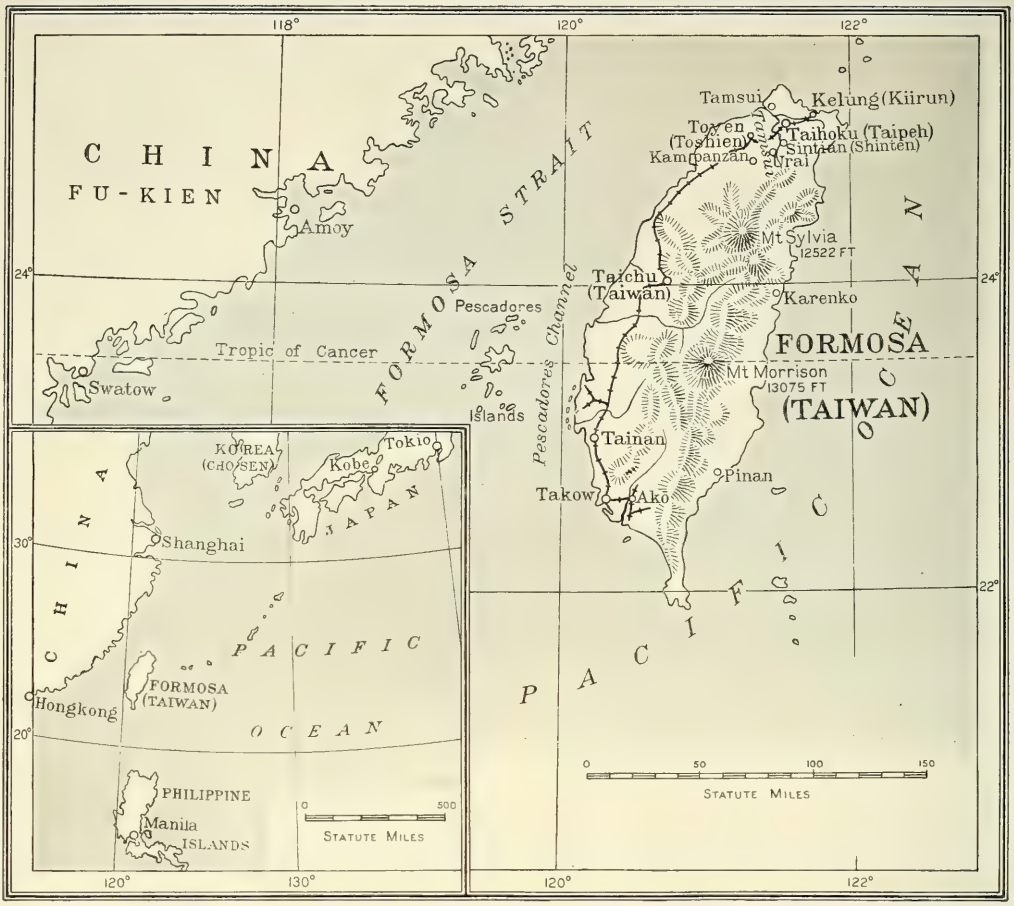
During the summer months Daitotei presents its busiest face, for it is then that the tea season is in full swing. The colonnades of the tea *hongs,* if such an imposing architectural term as colonnades can be fittingly applied to such unimposing structures, are ahum with the staccato accents of chattering tea-pickers. These are generally young girls, as old hands are too numb for the deft manipulation of the tea leaves.

Seated on low stools before wide wicker trays, these bright-eyed maids, in their peacock-blue smocks, their front hair clipped in bangs, and with a gay posy or two stuck in the braided knots at the backs of their necks, are in animated contrast to their rather drab surroundings.

With flying wisps of fingers, at least one of which on each hand has a long, carefully trained nail, a rather inconvenient concession to a fashion which originally spelled leisure, they separate the coarser twigs from the partially fired tea leaves; and, just as in all probability well-bred western matrons will exchange a few words of gossip over their cups of tea, these cheerful tea-picking girls start the ball a-rolling on this side of the globe.

Not so many years ago the tea-chests were decorated by lightning artists with tropical-looking birds and beasts, but now designs are stenciled on sheets of paper, which are pasted on the boxes and glossed over with varnish.

Everywhere we saw coolies packing these gaily-flowered, lead-lined boxes that carry their sensitive freight of tea to America. I say America, for about 90 per cent of Formosa Oolong goes to the



A MAP OF FORMOSA (TAIWAN) SHOWING ITS GEOGRAPHICAL RELATION TO JAPAN, CHINA, AND THE PHILIPPINES

United States. The little that goes to England is generally used in making choice blends in combination with other teas.

GUARDING TEA FROM OBNOXIOUS FREIGHT

As an additional protective measure, each chest is sewn up in reed matting. So sensitive is tea to other freight that a tea merchant, before he loads his cargo, has to find out what goods a ship is carrying in her hold. Tea and copra, for instance, cannot travel together with anything approaching congeniality. Moreover, if it so happens that some Asiatic disease breaks out on the ship and the hold is fumigated, the tea might just as well have caught the disease and died, for its commercial life is at an end.

Besides the Oolong tea, whose natural fragrance is of the sort to commend itself to the most fastidious tea-bibber, there is an artificially scented tea, called Pouchong, produced in Formosa. This is exported chiefly to the Philippines and the Straits Settlements for Chinese consumption.

Four kinds of flowers are used in the process of scenting Pouchong—two varieties of jasmine, white oleanders, and gardenias. These flowers are grown in great quantities outside the city of Taihoku for this purpose, and are bartered on a certain street corner in Daitotei.

I shall always recall this street corner as the abode of Perfume—an oasis of Fragrance in a hostile desert. Coming down Hokumongai, the principal street in Daitotei, the sensitive western nose is

A NATIVE CAMPHOR STILL IN THE HEART OF A CAMPHOR FOREST

Native stills are scattered here and there throughout the camphor districts, where crude camphor is collected, packed in tins, and carried down precipitous mountain paths on coolies' backs to the nearest railway line, whence it goes to the refinery in Taihoku.

A CAMPHOR TREE

The camphor trees are unusually beautiful, with shapely trunks and wide-spreading branches profusely covered with graceful leaves of a soft green. According to an article appearing recently in a semi-official publication of Formosa, the camphor produced in the island at the present time is obtained entirely from natural-grown camphor trees, the supply of which, it is anticipated, will be exhausted within ten years. For more than a decade, however, the camphor monopoly bureau has been planting camphor trees at the rate of more than 3,000 acres a year. In 1919 its program was expanded to more than 12,000 acres, and this will be the annual acreage planted in future.

regaled by a thousand conglomerate Chinese odors—Chinese joss-sticks and Chinese fire-crackers, Chinese clothes and Chinese food, Chinese shops and Chinese houses, Chinese men and Chinese women. Then of a sudden comes this flower mart.

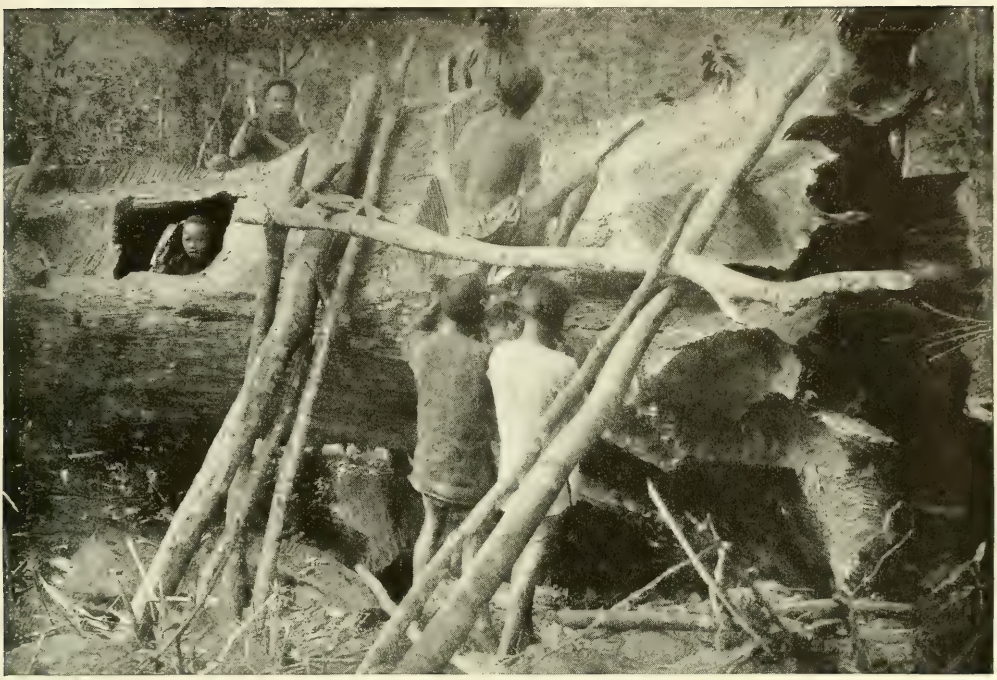
The handkerchief drops to the lap and the owner of the sensitive nose "sits up and takes notice." Are these white waxen blossoms really the gardenias we were wont to revere on account of their expensiveness? Let us try to imagine the qualms of some Fifth Avenue florist if he could but see so many potential boutonnières, at a dollar apiece, so carelessly heaped up in baskets, lining the dingy pavement.

SEARCHING FOR SMUGGLERS

However, it is to the waterfront of the Tamsui River, commonly called the Bund, that we must go if we wish to see the most picturesque part of Daitotei. Here it is that junks, with great eyes painted on the sides of the bow, bring cargoes from the ports of Tamsui and Kelung. Their antique sails, patched and repatched, speed the oarsmen when sailing downstream with the wind, but against both wind and the tide the progress of these clumsy craft is slow indeed.

The customs jetty is the scene of the most animated discussions, for the customs officials are very thorough in their search for smuggled goods, and the junk-owners, many of whom bring wares from the China coast, are just as eager to assert their innocence. More often the barter is merely in local products, such as charcoal from some hillside kiln a few miles upstream, or sweet potatoes, which with the soaring price of rice are a chief staple of diet among the poor.

A junk's crew has no regular meal hours. At almost any time, while the



A CHINESE FAMILY WORKING A CAMPHOR TREE

Few trees can rival the camphor in value. An average tree, twelve feet in circumference at its base, will yield about fifty piculs of camphor (approximately 6,660 pounds), which at the present market price is worth about $5,000.

boats weigh anchor, a small party can be seen in the stern, clustering about a charcoal brazier—a woman busy dishing out bowls of soup and macaroni, and men in palm-leaf hats, their bronzed bodies stripped to the waist, hurriedly scooping up steaming threads with the aid of long wooden chop-sticks.

Every hour of the day the river is aglow with life—women washing their clothes; the footsore washing their feet; duck-tenders giving their broods a swim; fishermen trying their luck; housewives cleaning their vegetables and strips of pork; cattle and their owners fording the stream at low tide; and, at sunset, dusky ghosts of sampans, laden with families living up the river, gliding homeward against a jonquil sky.

FORMOSA THE HOME OF CAMPHOR

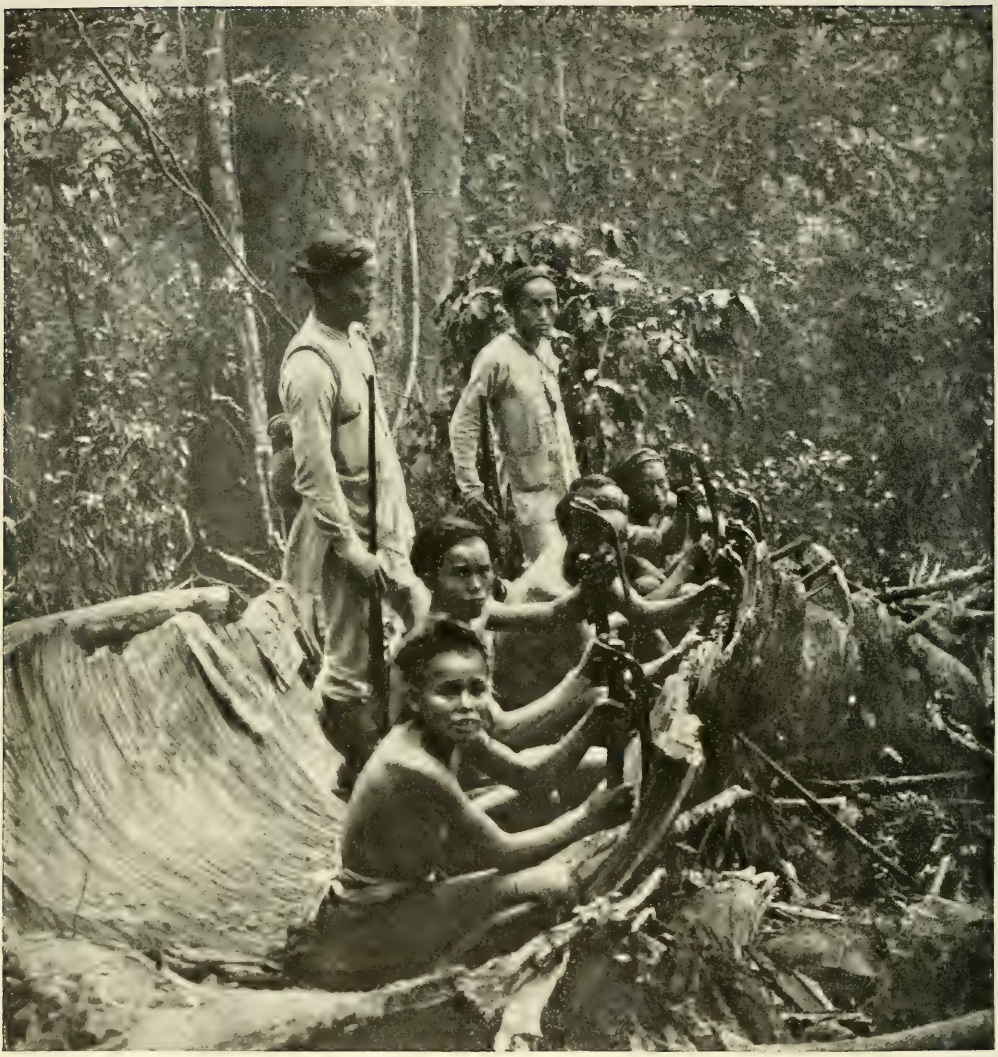
The population of Formosa is mainly agricultural. The cultivation of rice, and more especially sugar-cane, is encouraged by the government, and these are grown in great quantities.

However, the most interesting industry is the production of camphor, and it can truly be said to be peculiar to the island, when it is remembered that Formosa holds a practical monopoly in the world's market of this valuable drug.

Before the war, Germany, by a secret process, succeeded in manufacturing some synthetic camphor, but so expensive was the labor entailed that the artificial product could not compete with the natural camphor, nor is it likely to do so for some time to come.

Shortly after the Japanese came to Formosa, 25 years ago, the camphor industry became a government monopoly. Before that time there had been a great deal of ruthless waste, both in the cutting down of trees and in extracting camphor from them.

At first the Japanese, too, were careless in this respect, for the supply of camphor trees seemed practically limitless, but the great increase in the demand for the product in late years has made scientific afforestation necessary. Now



IN MANY DISTRICTS CAMPHOR WORKERS REQUIRE THE PROTECTION OF ARMED GUARDS

Tales of the camphor workers recall the days of our pioneer fathers, who constantly faced the dangers of tomahawk and scalping-knife.

large tracts of land are given over to the cultivation of the camphor laurel. The oldest of these cultivated trees are now twenty years of age, and these, I am informed, are to be cut down next year.

Paradoxical as it may seem at first glance, the savage head-hunters of Formosa have been both an impediment and a boon to the camphor industry.

As the forests are cut down, the head-hunters have to be driven further back into the mountains. These expeditions against the savages are never very successful, encountering as they do heavy obstacles in the way of dense forests, rapid streams without bridges, steep mountains without trails, and, above all, the danger of sudden attack.

The life of a camphor worker is indeed an adventurous one; he is never

GOUGING CHIPS FROM A CAMPHOR TREE

The adz is used in reducing the camphor tree to chips, which can be placed into retorts for the distillation process (see illustration on the next page).

safe. Although a woodsman with an axe never moves except in the company of an armed guard, there is always danger of an ambush.

Tales of the camphor workers recall the days of our pioneer fathers in the times of the tomahawk, the poisoned arrow, and the scalping-knife. And yet if this menace had not existed, the camphor forests would have disappeared long ago. Thanks to the head-hunters, there are still large tracts of virgin camphor forests in Formosa.

Camphor trees grow best on moderate, well-drained slopes, not over 4,000 feet in elevation, where the sun's rays can reach them.

Nowhere else in the world have these trees attained such height and girth. In the past, trees with a basal circumference of from 35 to 40 feet have been noted, but these have inevitably fallen

PLACING CAMPHOR CHIPS IN THE CHIP RETORT

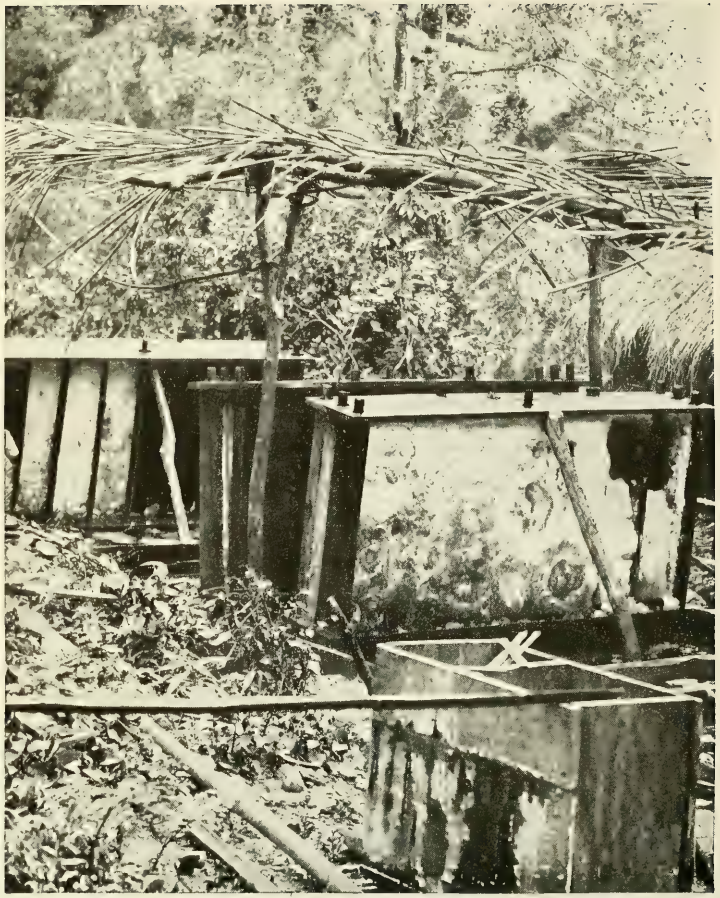
The retort is above boiling water. Beneath is a furnace. To the right a man is removing the chips from which the camphor has been extracted.

DRAINING OFF THE OIL FROM THE CAMPHOR: FORMOSA

Here we see the camphor placed on wooden troughs, and whatever free oil it contains drains off into tin pails.

SUBMERGED VATS USED IN CAMPHOR PRODUCTION

As the camphor vaporizes it passes through pipes into the submerged vats, which are so arranged that cool water from a mountain spring can flow over them to hasten crystallization. In the accompanying illustration the vats are shown after being lifted out of the water.



THE RAISED VATS CONTAINING CRYSTALLIZED CAMPHOR

In recent months the demand for Formosa camphor has been exceedingly heavy, especially among celluloid manufacturers. For the first three months of 1920 the Japanese Government has allotted to the United States 379,635 pounds.

victims to the woodsman's axe. Perhaps in the uncharted forests, where the savage still holds sway, more of these noble specimens still grow unscathed. At present a camphor tree with a basal circumference of 20 feet is considered a very ample specimen.

A SINGLE TREE PRODUCES $5,000 WORTH OF CAMPHOR

In point of view of value, few trees can rival the camphor. An average tree, say with a basal circumference of 12 feet, will yield about 50 piculs of camphor (approximately 6,660 pounds), which, at the present market price, is worth about $5,000.

Strictly speaking, there are no camphor forests, as the camphor laurel is only one of a number of trees growing together. The camphor trees are unusually beautiful, with shapely trunks and wide-spreading branches profusely covered with graceful leaves of a soft green.

Native stills are scattered here and there throughout the districts where crude camphor is collected, packed in tins, and carried down precipitous mountain paths on coolies' backs to the nearest railway line, whence it goes to the refinery at Taihoku.

It was my good fortune to visit one of these native stills in the district about ten miles beyond Urai, the first savage village with a police garrison to the south of Taihoku.

We motored as far as Sintian, and from there the stronger members of the party "hiked," while the rest alternately walked and rode in sedan chairs.

We had to cross many streams and we always found a Chinese ferryman with a sampan awaiting us on the bank, for our route had been kindly prearranged by the Japanese official from whom we obtained permission to enter the savage zone. There seemed to be no fixed fare, and the sampan owner accepted, as a matter of course, the few coins we tossed him on alighting.

AN ENCOUNTER WITH A "BROTHER" FORMOSAN

The ferryman at the last stream we crossed was an old "ripe" savage, with a face seared and seamy. A veritable Charon he looked, and this resemblance was heightened by a dark-colored shawl thrown over his head, for the poor fellow suffered from ague.

He regarded us with much solemnity, and I for one was trying to fathom his thoughts, when quite unexpectedly he spoke, "You and I are brothers. We are not like these," and he indicated the few Japanese and Chinese passengers at the rear of the sampan.

I was somewhat surprised, but found that all the Formosan savages have this idea. Besides themselves the world contains for them but two groups, the Chinese and the Japanese; so when they meet persons belonging to neither of these, by a process of elimination they claim them as relations.

At Urai we stopped for luncheon at a Japanese inn, and the entire savage population turned out to watch us eat. It happened that we had some caviar sandwiches in our lunch baskets, and when we had finished eating, as I had one left I gave it to an old savage chief. He ate it with great relish, and when he was through he signified his desire for more. Then I gave him a plain bread-and-butter sandwich, and his disgust was amusing to behold.

Whenever I hear of savages assimilating most eagerly the evils rather than the more substantial benefits of civilization, I think in particular of this born epicure. I am sure he would have preferred champagne to beer at first draught.

THE SIMPLICITY OF THE CAMPHOR STILL

The still we visited was operated by the members of one Chinese family. When our party approached, some of the men were gouging chips from the trunks of camphor trees with adzes, while others were in the still feeding the fires.

Adjoining the still was a shanty, where the workers lived, and in front of the door was a woman preparing the afternoon meal, while beside her a little boy was busy playing blocks with chips from which the camphor had been extracted.

The stills are operated in a very simple manner. Camphor chips are placed in a chip retort over boiling water, and as the camphor vaporizes it passes through

A PINE-CRESTED RIDGE

This photograph might have been taken in New England except for the "ripe" savages carrying guns. The border savages are often employed to assist the police guard.

pipes into submerged vats, which are so arranged that cool water from a mountain stream can run over them to accelerate crystallization. After the camphor has crystallized the vats are opened, and the product is placed on wooden troughs to allow whatever free oil there may be to drain off. This oil will yield 90 per cent of crude camphor in the process of refining.

THE PEOPLE OF FORMOSA

Ever since we have any authentic record, Formosa has been peopled with wild tribes of probably Malayan and Polynesian origin. They are nearest in point of resemblance to the Dayaks of Borneo, and although their origin has never been proved beyond a doubt, they are sufficiently like certain of the South Sea tribes to justify us in ascribing to them a common ancestry.

They are found on the island today in all stages of development. The "raw" savages, as the Chinese term them, live much as their ancestors did centuries ago, while the "ripe" savages, living on the borderland between their wild kin and Chinese settlers, have more or less assimilated Chinese ways of life.

The savage population of Formosa is estimated at about 150,000. There are eight main groups of savage tribes on the island, each group with fairly well-defined differences of dress, speech, and customs, and in many cases the tribes that make up a group display minor differences among themselves.

LUMBERING OPERATIONS IN THE HINOKI FORESTS ON MOUNT ARIZAN

Next to the camphor laurel, the hinoki, or sun trees, are the most valuable trees in Formosa. The tallest specimens attain a height of 130 feet and are of such girth as to enable a dozen people to stand on the stump of a tree that has been felled.

Although in most instances the similarities are more striking than the differences in the various groups, still they are sufficiently unlike to lead us to suppose that they migrated to Formosa at different times and perhaps from different places.

A PASSION FOR HEAD-HUNTING

There is one trait that all the "raw" savages possess in common, and that is their passion for head-hunting. With some of the groups the practice is closely bound up with their religious and social life, while with others it is more especially a question of prowess, and the brave who can display the greatest array of skulls is regarded as the greatest hero.

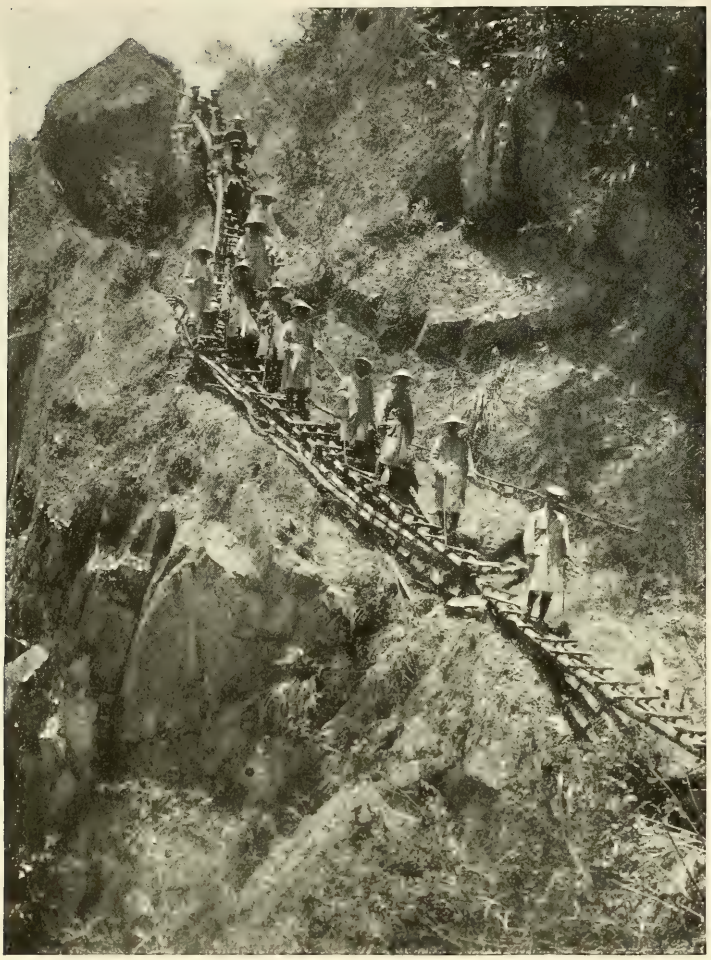
The "ripe" savages have, of course, abandoned the practice altogether, but they still cherish a sneaking affection for it, as is shown by their adherence to the old dances which originated in the festivities over the capture of heads.

In every savage village the open-air skull museum is a matter of civic pride, and most chiefs have their private collection of skulls as well.

At the time that the Chinese army of occupation left Formosa and the Japanese entered their new domain, guns were at a premium. As the Chinese residents were not allowed to retain fire-arms, nearly all the rifles belonging to the departing army, numbering about 20,000, were sold by Chinese traders to the savages. It is this possession of fire-arms that makes the head-hunters particularly dangerous to cope with.

THE LIVE-WIRE BARRIER

It is so common for some Chinaman living near the savage border to lose his head that not much attention is paid to the incident, unless his relatives band together to avenge the murder. But if some Japanese policeman, official, or soldier falls a victim, there is always an expedition to avenge his death. A village is forewarned, and if the culprit is surrendered all are spared except the guilty one, who pays the death penalty.



JAPANESE INFANTRY DESCENDING A MOUNTAIN IN THE SAVAGE DISTRICT: FORMOSA

The men employed to safeguard the camphor workers are known as "Aiyue" (Guardsmen), and their outpost line as "Aiyu-sen" (Guard-line). The line is established by cutting a path along the crest of mountains, after which the jungle is cleared away for 18 or 20 feet on both sides; guard-houses are established at strategic points and wire entanglements charged with electricity are constructed.

At present Formosa enjoys greater freedom from savage attacks than ever before in her history. This is due to the fact that the Japanese have installed a live-wire barrier from Karenko, about midway on the east coast, to Pinan, in the south, a distance of about a hundred miles, to serve as a protection against savage raids.

The trees for twenty feet on both sides of the barrier have been cleared away to prevent the savages from crossing the wire by felling trees on it.

At distances of every half mile along the route blockhouses are stationed, and a sentry paces the beat between two posts all day long to see that the wire has not been tampered with or any holes burrowed underneath.

At first the electric current was turned on only at night, the usual time for a savage raid, but the wily head-hunters soon discovered this, as they noticed that no smoke issued from the power-house by day. Then, as they turned their night raids into daylight expeditions, the Japanese were obliged to turn on the current by day as well.

This device, although not exactly a cheap one, has done much to develop the fertile plain to the west of the barricade, as many Japanese agriculturists have been attracted to this region, now that they can live there in comparative safety.

Even now traders, who go as far as the barricade to exchange small wares for deer horns and tortoise shell, occasionally lose their lives, when they venture singly or are careless about going unarmed.

There are two kinds of deer, Formosa spotted deer and Swinhoë's rusa deer, that roam in large numbers on the mountains occupied by the savages, and on the seacoast back of them are found enormous turtles, varying from three to five

A MILITARY GARRISON ON THE BORDER OF THE SAVAGE DISTRICT: FORMOSA

These temporary structures serve as the headquarters of the commanding officer during an expedition against the savages.

feet in length and from 200 to 400 pounds in weight.

DIFFICULT TO STUDY THE SAVAGES

It is through a study of some newly conquered tribe that we come to know the characteristics of the Formosan savage.

Even though the ardent student of anthropology cared to risk his life among the "raw" savages, permission to enter the danger zone could not be obtained from the Japanese authorities. In fact, the Japanese are so careful in this respect that even when foreigners want to visit a village of "ripe" savages they must always be accompanied by a police escort.

It is not my purpose here to write a descriptive history of the savage tribes on this island, having no first-hand knowledge on the subject, but I wish to relate the story of a trip I took to Kampanzan, a little savage village in the north of the island, and of an interesting encounter with Kim Soan, a savage, which throws some new sidelights on the life of his tribe, the Atayals of North Formosa.

We started out by train to Toyen, a two hours' ride, on a beautiful day last autumn. It was the time of the second rice harvest, and in the paddy-fields were scattered little groups of laborers in their broad palm-leaf hats, some reaping the grain with sickles, others threshing, and still others plowing the fields for the new seedlings.

Sunny blue skies overhead and the soft browns of the ripened grain, interspersed with vivid green patches of the young seedlings, formed the color scheme of the picture before us, and the frame was the encircling mountains.

WESTERN INVENTIONS BECOME ORIENTAL COMMONPLACES

Very picturesque were the portable tubs with their canvas awnings, looking for all the world like sails, in the wake of which followed the threshers with their bundles of grain, which they rapped smartly against the corrugated board

A BRIDGE CONSTRUCTED BY THE SAVAGES

Of course, when the heavy rains come, this bridge will be carried down-stream.

affixed to the tub, to separate the rice from the blade.

Picturesque, too, were the foot pumps, worked by three and sometimes four coolies, in pumping water from one field to another. These were the invention of a Spanish missionary and are used in China as well.

It would be interesting indeed to find out how many of the inventions of which we think as typically Oriental have originated in Western brains. I call to mind the tonga, a vehicle used all over Central India, the invention of an American missionary; and more especially the jinrikisha, the first one of which was constructed by an American missionary in Japan for his lame wife, and which is now used all over the East.

EVERY BUFFALO HAS ITS FRIENDLY HERON

The plowing is done by water buffaloes, which are brought down from their mountain pastures, where they return to graze when their work is finished. No rural Formosan landscape is complete

A RATTAN SUSPENSION BRIDGE CONSTRUCTED BY THE JAPANESE IN THE SAVAGE COUNTRY

The longest structure of this kind in the island is more than 400 feet in length. Even in flood times this footbridge swings safely above the foaming waters.

MOUNT MORRISON, 13,075 FEET IN ELEVATION, THE HIGHEST PEAK IN THE JAPANESE EMPIRE

AS CAN BE SEEN FROM THIS PICTURE, AN EXPEDITION AGAINST FORMOSAN SAVAGES HAS TRIALS ALL ITS OWN

"These expeditions against the savages are never very successful, encountering as they do heavy obstacles in the way of dense forests, rapid streams without bridges, steep mountains without trails, and, above all, the danger of sudden attack."

THE RAILWAY BRIDGE AT AKO, SOUTHERN FORMOSA
Harbor improvements, railways, and bridges have greatly facilitated traffic.

without at least one of these hulking creatures, with its lowering horns and great staring eyes. Their hides are just the shade of weathered rock, and so motionless do they stand for hours while grazing on some grassy slope that they look, even from a short distance away, as if they were carved from stone.

Wherever there are buffaloes, graceful white herons are seen perched on their backs. It seems, indeed, that each buffalo has a particular heron for a pal, who takes care to rid him of smaller friends, just as devoted, perhaps, but less desirable.

At Toyen we took push-cars. These are small, wicker-covered chariots on narrow-gauge rails. The seats are just large enough to accommodate two passengers, and there is a small platform behind, where the two coolies who push the car on the upgrade can stand and ride when the route lies down hill.

The confirmed motorist would find these push-cars a bit tedious on the level or upgrade, but going down mountains they leave nothing to be desired in the way of thrills.

Our route lay for the first hour through level country. We passed through fields of sugar-cane, with occasional patches of sweet potatoes, cabbages, and pumpkins. And now and then we came upon some Chinese village near a stream, where our approach was heralded by the shouts of children.

Women tugging small babies would hobble out of their doorways as fast as their bound feet would permit and exchange laughing comments on our appearance. Young men would frankly jeer at us, and only the old men, like figures in ivory yellow with age, gazed upon us with imperturbable calm.

A JOURNEY WITH EVERY VISTA A PICTURE

At length we started the ascent. At first our way lay through terraced tea gardens and groves of pineapples, bananas, and citrus fruits; but as we progressed the mountain sides became covered with Nature's own rich mantle. Ornamental grasses fringed our path, while through the bracken and lichened rocks projecting overhead little bubbling freshets trickled down at our feet.

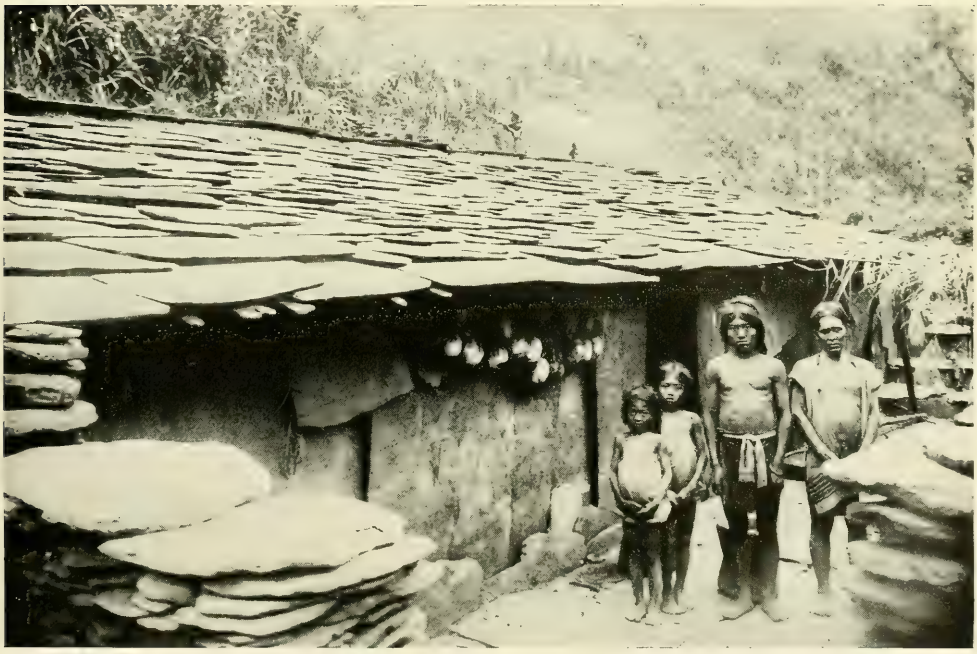
THE SCHOOL FOR SAVAGE CHILDREN AT KAMPANZAN, A MOUNTAIN VILLAGE IN NORTHERN FORMOSA

A SAVAGE PALAVER-HOUSE

Most of the savage groups have these dwellings, which serve the double purpose of club-houses and bachelor dormitories.

A THATCHED-ROOF TYPE OF SAVAGE DWELLING

These natives are displaying some of their hand-made pottery.



A SAVAGE DWELLING WITH SKULLS HANGING FROM THE RAFTERS

Whenever savages live in the vicinity of slate quarries they construct their homes from slabs of slate.

THE DEEPLY DENTED TATTOO-MARKS INDICATE THAT THIS ATAYAL SAVAGE HAS ATTAINED MANHOOD'S ESTATE

It is perpetual leap-year in the Atayal country, for the woman has an equal right with the man to choose her mate, the bride prospective going to the house of the man or he going to hers. No one is allowed to have more than one partner or to marry into another tribe.

A WOMAN OF THE ATAYAL GROUP WHOSE TATTOOING DENOTES THAT SHE IS OF MARRIAGEABLE AGE

Both the men and women of this group are fond of necklaces and bracelets and other ornaments made of the teeth of animals, hard red berries, brass and other metals. They remove from the upper jaw the two lateral incisors to improve their appearance.

Every bend in the path brought to view some new slope more exquisitely arrayed than the last—a profusion of tropical foliage plants, elephants' ears, plantains, and tree-ferns intermingled with flowering shrubs of many varieties, wild hydrangeas, morning-glories, pink oleanders, hibiscus, and the lovely gold-banded lilies of Japan.

Kampanzan itself is not over 2,000 feet in elevation, but the mountains surrounding it form a splendid setting, the lower hills densely wooded and the higher veiled in clouds and snow.

Toward dusk we arrived at the savage village, tucked away in a valley between two mountains. Smoke clouded the doorways of the mud, grass-roofed huts, for within savage mothers were boiling their evening meal of sweet potatoes over wood fires in the center of the floor.

Children ran out at our approach, their eyes quite wet and streaming tears from their recent smoke bath, while their sires, one-time braves, but now mere blear-eyed phantoms of savagery, squatted in front of their houses and blinked at us, as we passed, between puffs from long thin pipes.

THE STORY OF KIM SOAN

We went to a small Japanese inn, and it was here that we met Kim Soan, after we had finished supper and were wondering how to spend the hour before bedtime.

He came as the messenger from the chief police official to inquire whether we had everything we needed for our comfort. A member of our party, who has lived many years in Formosa and speaks fluent Chinese, requested him to convey our thanks to the police official, and then return to us for a talk. After he had gone our friend said, "I know that man; his face comes back to me," and he told us what he knew of Kim Soan's history.

When the Chinese were still in possession of Formosa—a period of gross misrule, from all accounts—there seems to have been one governor with a few advanced ideas. He conceived the scheme of educating the young boys of conquered savage tribes and sending them back as apostles of light to their people. But he reckoned without the volition of his pupils, as in the case of Kim Soan, who was one of these boys, and who after he had become attached to the amenities of civilization refused to return to savagery.

Later, when the Japanese came to the island, Kim Soan was commissioned to accompany two Japanese officials who were going to enter the savage territory to take the census. The three set out, all dressed alike in Japanese garb, and they had not proceeded very far when they were attacked by some savages, who killed the two Japanese, but spared Kim Soan.

He returned to report the murders to the authorities, and they, in turn, condemned him to die, deeming him responsible for the two deaths. He managed to escape, however, and fled to the mountains, where he stayed for eight years. Then he received his pardon, returned to the plains, and was made an instructor in the school for savage children at Kampanzan.

"HOW MANY HEADS DID YOU CUT OFF?"

Our companion had hardly finished this narrative when Kim Soan himself reappeared. The conversation which took place between the two follows:

"Don't you remember me, Kim Soan, and the little school at Tamsui that you used to attend?"

"Oh, sir, that is a long time ago—so long that it seems like a dream."

"So you became a savage again. How many heads did you cut off?"

This remark had the effect of a bomb. Instantly Kim Soan leaped to his feet, and raising his hand, his voice choking with emotion, said very solemnly, "I swear by the heavens above and the earth below my feet that I have never been guilty of taking any human life."

"But you have the tattoo-marks on your forehead that indicate that you have been admitted into the council of the men of your tribe. Surely you must have procured at least one head to enable you to accomplish that?"

Again he asserted his innocence with the same impressive solemnity.

"Then you must have accompanied the others on some head-hunting raid. You couldn't refuse to go, could you?"

Photograph by T. MacGregor

A GROUP OF KAMPANZAN SAVAGES

The savages in the northern half of the island are distinguished from the southern natives by their tattooing. The southern savages are not given to this practice. Of the northern tribes the one scattered over the largest area is the Atayal group, to which the Kampanzan savages belong. They live in mountain recesses, are among the least civilized of all the inhabitants of Formosa, and are especially partial to head-hunting.

"No, I couldn't refuse. I always tried to find some excuse, but finally our chief said, 'Tomorrow you go.' Then we shook a tree full of birds to read the omens from their flight, and the old woman of our tribe said, 'It is well; you will be successful.'

THE DOUBLE ASSASSINATION

"That night I went to bed with a heavy heart, and when I slept I dreamed that we would meet a woodsman with an axe and a guardsman with a rifle.

"On the next day it turned out even as I dreamed. My companions shot the guardsman through the heart from an ambush ten feet distant, and the woodsman threw up his hands and begged for mercy.

"I pleaded with my companions to spare his life, and they said, 'Fie! shame upon you! You have a Chinese heart.' Then

they turned upon me to kill me as well, so I withdrew my petition. After that they cut off the woodsman's head, and we returned home."

"And didn't you take part in any more raids after that?"

"Yes, one more. Once we lay in ambush in some tall grass as some Japanese infantry were coming along. They were very brave, those men, for though we shot down the first ones, the others kept right on coming. Soon, however, we were forced to make our escape, for they far outnumbered us. We respect the courage of the Japanese soldiers, but the Japanese policemen — bah! they scuttle away like mice at the first glimpse of us."

HOW WOULD YOU LIKE TO MEET US IN THE DARK?

An old savage chief and his wife. The former was told to dress up as he would to go on a head-hunting raid.

WOODEN BULLETS THAT EXPLODE

Then we asked Kim Soan many questions, and he gave us many interesting answers. He told us of the blacksmiths of every tribe who kept the guns in good condition. He contradicted the rumor that arms and ammunition are still smuggled into the savage territory.

He related to us how the savages make bullets from the heart of a very hard wood cured by a special process. These bullets are only effectual when fired from a short range, and when they lodge in the flesh they explode like dumdum bullets.

He also explained to us the ingenious way in which the men of his tribe make caps. Two small disks are cut from the striking side of a safety match-box, the tip of a match is placed between, and then the disks are glued together. He told us that they were always able to buy as many matches as they wanted from Chinese traders.

For hunting birds and beasts, he stated, bows and arrows were used, and all their ammunition was saved to hunt men.

THE BLOODY HAND A PASSPORT TO THE SAVAGE HEAVEN

"But why do your people hunt heads? Is it true that a man must procure a head before he can claim a bride?"

"No, it isn't that; but, of course, the women prefer the men that have brought back the most heads. But it's this way:

THE HOME OF A SAVAGE CHIEF: FORMOSA

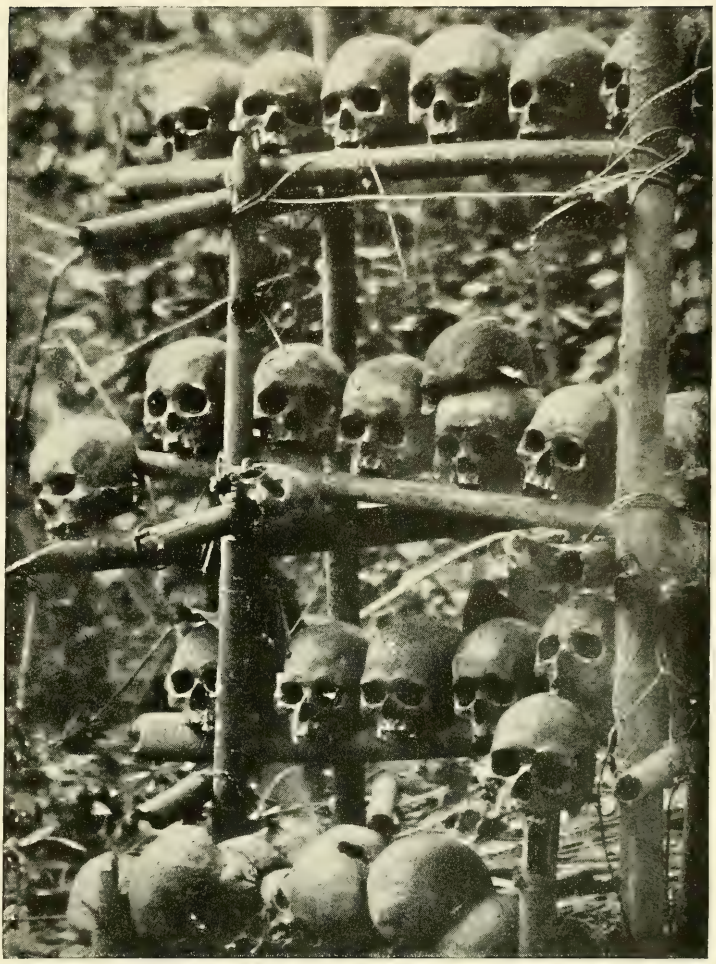
In nearly all the savage groups the home of the chief is distinguished by the crude carvings of human figures over the doorways. Note the skull on the shelf at the left.

AN OPEN-AIR SKULL MUSEUM

"In every savage village the open-air skull museum is a matter of civic pride."

all my people believe that when we die we all must walk up the rainbow to the Land-of-After-Death.

"At the end of the rainbow the gateman stands, and when we come he will say to us, 'Show me your hand.' And he will look at our hand, and if he finds it clean he will say, 'Go to the right,' and he will kick us into the dark nothingness below; but if he looks at our hand and finds it stained he will say, 'You may enter,' and he will allow us to pass within."



"ALAS, POOR YORICK, I KNEW HIM WELL!"

A nearer view of a skull museum, showing the trophies placed on bamboo poles.

JAPANESE SCHOOL FOR SAVAGE CHILDREN

Before we left Kampanzan we visited the savage school in which Kim Soan was a teacher. The children sang the Japanese national anthem for us with very pleasing voices. I have never heard Japanese or Chinese children sing half so well.

Then several of the children made speeches, which were very amusing, as they were so obviously the product of the teacher's pen. Each speech started somewhat as follows: "I am a poor little savage boy. Before the kind Japanese came here, I was very ignorant. Now my kind teacher is teaching me many things," and more of the same sort.

The Japanese are taking steps to train the savages in certain manual arts, chiefly cloth-weaving on hand-looms, so that they can earn their living, now that they can no longer follow the more exciting life of the chase.

I left Kampanzan with a feeling of depression. There is something poignantly pathetic in the spectacle of these wild creatures of the forest tied down to a dull domesticity, even as wild beasts captive in cages.

FORMOSA ONCE THE STRONGHOLD OF JAPANESE AND CHINESE PIRATES

The bulk of the population of Formosa is, of course, Chinese. Several centuries ago the island used to be the stronghold of both Chinese and Japanese pirates, who found it a very convenient base from which to intercept vessels following the trade routes between Japan and the rest of the Orient.

It was not until the fourteenth century

SAVAGES CARRYING WATER IN BAMBOO POLES

This practice is only one of many points of resemblance between Formosan savages and South Sea tribes.

A SAVAGE WOMAN WEAVING CLOTH ON A HAND-LOOM

BLACK TEETH AND FLAT, ROUND BAMBOO EARRINGS ARE HIGHLY PRIZED AMONG THE SAVAGES OF THE PAIWAN GROUP OCCUPYING SOUTHERN FORMOSA

It was upon the Paiwan savages that the Japanese wreaked a bitter vengeance in 1872, following the massacre of a crew of shipwrecked Japanese sailors.

FANTASTIC EFFECTS IN MILLINERY DISTINGUISH THE ORNAMENTATION OF BOTH MEN AND WOMEN OF THE TSUO GROUP

This tribe has a unique organization. All the land is owned by one clan, the Hyofupa, to whom every tribesman gives a tithe of his annual harvest. A public council hall, called the Kutsuba, is used as a lodging place for all unmarried youths more than 12 years of age. These boys are subjected to Spartan hardships in training to foster discipline, courage, and virtue.

THE BELL-SHAPED EARRINGS AND CHAPLETS OF BONE AND BEADS INDICATE THAT THESE SAVAGES BELONG TO THE VONUM GROUP

According to a tribal legend, the Vonum Group of Formosan mountain savages lived in the plains until the misfortune of an all-destroying deluge befell them. With the flood came a huge serpent, which swam through the stormy waters toward the terrorized people. They owed their deliverance from the great snake to the timely appearance of a monster crab, which, after a terrific battle, succeeded in killing the reptile.

that the first industrial class of Chinese, the agriculturist Hakkas, who were outcasts in their own country, came to settle in Formosa. After that, at the time of the Tatar invasion, several thousand Ming loyalists sought refuge on the island.

Then there has always been more or less of an influx of immigration from the overpopulated province of Fu-kien, just across the Formosa Straits. These Chinese from Fu-kien far outnumber the others, and their speech, known as the "Amoy dialect," is the vernacular of the island.

When the Japanese came into control of the island after the Chino-Japanese War, in 1895, a third element was added to the population.

THE WORK OF THE JAPANESE

The Japanese have instituted great material improvements in Formosa. The most important, of course, are the modern courts of justice in lieu of the old mandarin courts, where the man with the greatest "pull," which, needless to say, spelled money, invariably won out. There is also greater security to life and limb now, for not only is the Japanese police system a most thorough and efficient organization, but the sanitary measures that they have adopted have practically eradicated such diseases as malaria and bubonic plague.

AN ERA OF PROSPERITY

Harbor improvements, railways, and bridges have greatly facilitated traffic, but the road systems, as yet, outside the city of Taihoku, leave much to be desired.

Education, too, has been advanced, but, owing to the policy of assimilation, native schools are not encouraged, and the percentage of Chinese children at-

A DANCE OF THE AMI GROUP: FORMOSA

The Amis have discontinued head-hunting, but they still adhere to the old dances, which originated in the festivities over the capture of heads.

WOMEN WATER-BEARERS OF THE PEPO GROUP

The members of this group are scattered over the broad tracts of level land in the western parts of Formosa. They long had intercourse both with the Dutch and the Chinese. Today they are scarcely distinguishable from the Chinese.

YOUTH AND OLD AGE

This tattooed design is peculiar to the Tsalisen Group, whose members ceased to hunt heads more than a century ago. They are now good farmers, and through their frequent intercourse with the Chinese have become skillful blacksmiths and carvers. Many of the women of this tribe wear dresses with long trailing skirts.

tending public schools is only a little over 13 as against a rate of over 95 for the Japanese children of the island. Opium smoking is controlled by license. About 2 per cent of the Chinese at present smoke opium, but eventually this will stop entirely.

The future of Formosa under its present benevolent paternal government looks bright, indeed. Never before has this island, so beautiful to the eye, enjoyed such a degree of prosperity. Old industries are thriving, new industries are cropping forth, foreign trade increases yearly, and the general welfare of the Formosan people is steadily improving.

NATIONAL GEOGRAPHIC SOCIETY NOTICE

The Board of Managers of THE NATIONAL GEOGRAPHIC SOCIETY report to the members the following proposed changes in the By-Laws of the Society:

That Section 2 of Article VII of the By-Laws be amended to read as follows:

"The annual dues of members shall be $2.50, payable in January.

"This amendment shall be effective as of January 1, 1920, but shall not apply to members who have paid their dues prior to its adoption."

That Article XII be amended to read as follows:

"These By-Laws may be amended at any meeting of the Board of Trustees by a two-thirds vote of the members present; provided, however, that notice of intention to amend said By-Laws has been sent to all members of said Board not less than thirty days prior to such meeting."

That Section 1 of Article IV be amended to read as follows:

"The direction and management of the affairs of the Society and the control and disposal of its property and funds shall be vested in the Board of Trustees, twenty-four in number. The Trustees shall hold office continuously. All vacancies in the Board of Trustees shall be filled by the Trustees."

A special meeting of the members of the Society is hereby called and will be held on the 15th day of March, 1920, at Hubbard Memorial Hall, Washington, D. C., at two o'clock p. m., for the purpose of voting on the above amendments.

By order of the Board of Managers: O. P. AUSTIN, *Secretary.*

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PEARY AS A LEADER

Incidents from the Life of the Discoverer of the North Pole Told by One of His Lieutenants on the Expedition Which Reached the Goal

BY DONALD B. MACMILLAN

"STARS AND STRIPES nailed to the Pole!"

The accomplishment of that which had been declared repeatedly to be the impossible, that which our strongest nations had striven to do for more than three hundred years, at the cost of many lives and the expenditure of millions of dollars, demanded great leadership.

What manner of man was this who persuaded the polar Eskimos to penetrate to the interior of the great *ser-mik-suah,* the abode of evil spirits; induced them to leave their homes and journey seven hundred miles due north; to travel out over the drift-ice of the Polar Sea so far that they declared that they would never again see their wives and children?

What was the secret of that power which he possessed over his white men that, had he wished, they would have followed him through broken ice, would have crossed treacherous thin leads, surmounted pressure ridges, and clung to him until the last ounce of food was gone and the last dog eaten?

We find the key to Rear Admiral Robert E. Peary's character in his reply to the late ex-President Roosevelt upon the presentation of the Hubbard Medal of the National Geographic Society upon the explorer's return in 1906 from the world's record of "Farthest North," when he said:

"The true explorer does his work not for any hopes of reward or honor, but because the thing which he has set himself to do is a part of his being and must be accomplished for the sake of its accomplishment.

"To me the final and complete solution of the polar mystery, which has engaged the best thought and interests of some of the best men of the most vigorous and enlightened nations of the world for more than three centuries, and which today stirs the heart of every man or woman whose veins hold red blood, is the thing which should be done for the honor and credit of this country, the thing which it is intended that I should do, and the thing that I must do."

Here we have energy, purpose, determination, and love of country—some of the essentials of a great leader, and as such we who had the honor of serving under him like to think of him, and such we know he was.

DEFYING THE GODS OF THE FROZEN SAHARA

On the 15th of July, 1886, far in on the back of the great ice-cap of Greenland, at an altitude of 7,525 feet, lay two

Photograph by Donald B. MacMillan

A MEMBER OF THE MAC MILLAN EXPEDITION FINDING PEARY'S CABIN AND RECORD AT THE NORTHERN END OF AXEL HEIBERG LAND, MAY, 1914

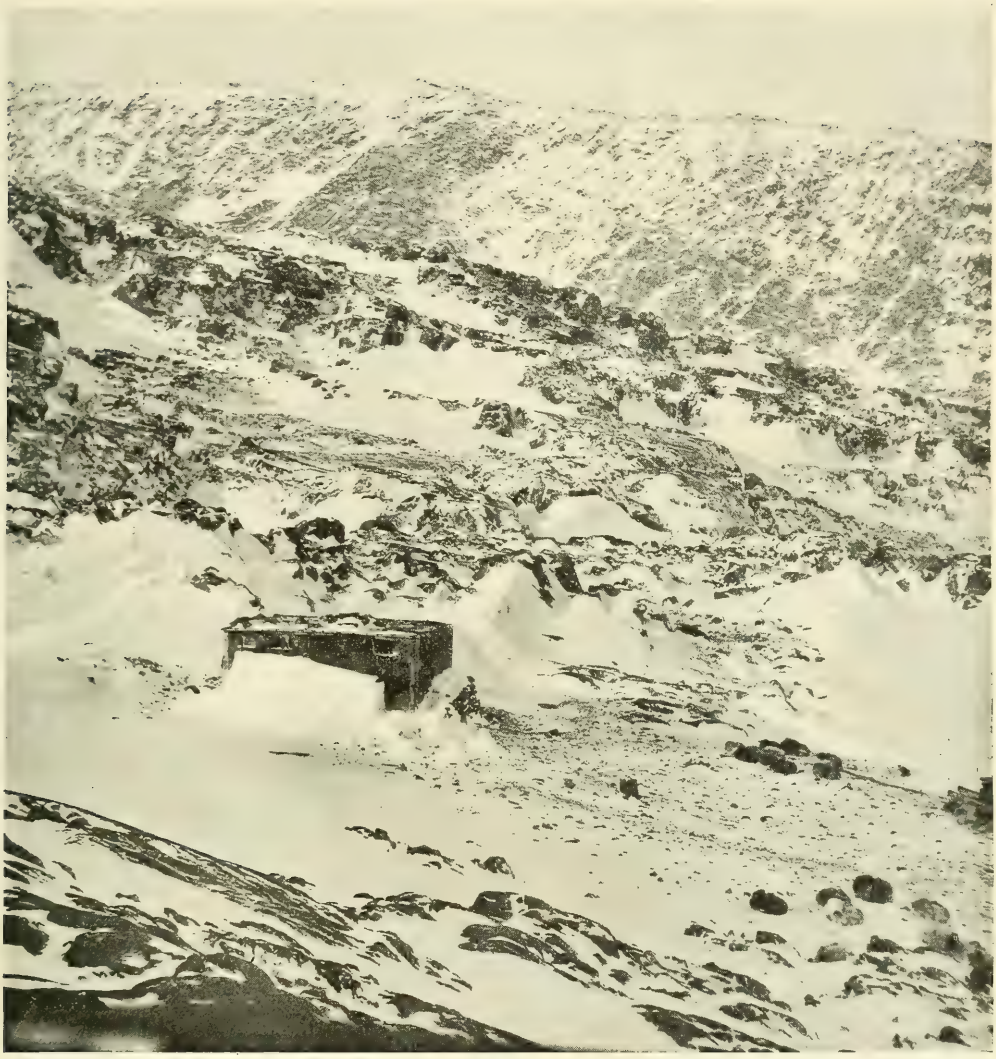
The Arctic explorer reached this point in June, 1906, on his return from "Farthest North," 87° 6′, reached in April of that year (see map, page 297, and text, page 300).

forms huddled in the snow. For forty-eight hours they listened to the sullen roar of wind and drifting snow across their bodies.

The jealous gods of that great frozen Sahara, guarding its secrets down through the ages, were justly alarmed at this invasion and looked in wonder at these pioneers who had the temerity to leave the comforts of civilization and flower-bedecked slopes of the Warm Greenland fiords and advance into the great white unknown, with its attendant severity of cutting winds and drifting snows.

These same gods must have laughed aloud five years later upon seeing a man lashed to a plank and landed upon their shores with a broken leg, far up at the head of Inglefield Gulf. This American explorer would not go home; he would do what he came to do!

And when the ship steamed out through



Photograph by Donald B. MacMillan

PEARY'S HUT AT CAPE SABINE, FROM WHICH THE EXPLORER MADE HIS DASH TOWARD THE POLE IN 1900

This refuge was formerly the deck-house of the steamship *Windward*, used by Peary in his 1898-1902 Expedition.

the broken fields of ice and disappeared over the southern horizon, these gods knew that here in the little tent on the beach was a man against whom immediate warfare must be declared and their strongest forces united (see also p. 319).

"MAN WAS NOT BORN TO DIE BENEATH SUCH A SKY"

At the first peep of dawn of the long Arctic day we find Peary accepting the challenge and assembling his forces at the edge of the ice-cap. On Independence Day the American flag was unfurled at Navy Cliff, some six hundred miles to the north.

When, weeks later, he struggles toward home over that apparently endless white waste, with inflamed eyes, frostbitten and sunburnt face, dropping dogs, and food nearly gone, he looks up into the clear heavens and declares that

"man was not born to die beneath such a sky."

Here was belief in self, hope, optimism.

Six years later, contrary to all Arctic precedent, he dared to harness his dogs, leave his ship frozen in the ice, and sledge northward in the middle of the big Arctic night.

With the thermometer at fifty and sixty below zero, not a particle of food in his sledges, he groped his way along the eastern shores of Ellesmere Land, around Cape Baird, and into Lady Franklin Bay, searching for the headquarters of the Greely Expedition, abandoned sixteen years before.

He stumbled through the door with both feet frozen to the ankles. Nothing could be done here to relieve his suffering. Toe after toe sloughed off. Finally he was lashed to a sledge and carried through the broken ice of bays and inlets and along the ice foot back to his ship, two hundred miles to the south. And with him, to aid in the amputation of the stumps of eight toes, went a can of anesthetic, found there in the house and brought into the Arctic regions in 1881.

Now a cripple? Within thirty-seven days following the final amputation he was headed north again, equipped with crutches!

The antagonistic elements of the Northland should have submitted meekly and bowed humbly, as this plucky little caravan wound its way up through Kennedy and Robeson channels with the great unknown as its objective point.

FIGHTING FOR THE LIVES OF HIS NATIVES

Two years later we find this intrepid man encamped on the bleak shores of Cape Sabine, surrounded by his loyal Eskimos, patiently perfecting his equipment and preparing for that hazardous trip of eight hundred miles to the top of the earth.

Every attack had been made upon him that Torgnak, the evil spirit of the North, could devise—bitter cold, cutting winds, blinding drift, treacherous thin ice, rough ice, pressure ridges, crevasses, *piblocto* among his dogs, frost-bitten face, fingers, feet, and starvation; yet his will was adamant, his body strong, his purpose unshaken.

And now a new mode of attack to thwart his plans, one cunningly devised and relentlessly executed—deprive him of the valuable services of his loyal Eskimos! Those were the darkest days of Peary's career, fighting not for the Pole, but for the lives of his natives, and with the same energy and determination which characterize all of his work. Six mounds of rock within a few yards of his wooden shack testify to his losing fight.

THE "ROOSEVELT" BEGINS HER CAREER

Four years he remained in the North, and returned scarred and temporarily beaten, but with a knowledge of why he was beaten—the secret of final success. His staunch friends believed in him and gathered around him, and in the fall of 1904 they saw the sturdy *Roosevelt* beginning to take shape under the skillful hands of Maine shipbuilders.

With engines throbbing under high pressure and smoke belching from her funnel, Peary and Bartlett fairly hurled this first American-built Polar ship around Cape Sheridan and into the Polar Sea, farther north than any other ship had ever steamed. She had done what she was planned to do; she had justified her existence; and there she lay, on the northern shore of Grant Land, panting like an athlete at the end of the race.

The sun dropped below the hills, darkness crept over the land, and in that great white expanse of snow and ice one thing alone betokened that man lived in what was apparently a world long dead or one unfinished by the hand of the Creator—a warm beam of light from the cabin of the ship.

Long before the sun returned the ninety-mile trail to Cape Columbia was patted down with the feet of more than two hundred dogs. From that point to the Pole the course lay straight out over the drift-ice of the Polar Sea for 413 miles.

"Impossible!" was the word brought back to the British Government by the British North Pole Expedition of 1875-76. Peary never recognized this word in connection with his life's work.

A MAP RECORD OF REAR ADMIRAL PEARY'S 20 YEARS OF POLAR EXPLORATION, FINALLY CROWNED WITH SUCCESS APRIL 6, 1909

Photograph by Donald B. MacMillan

BUILDING A SNOW HOUSE AT PETERAVIK, THE SPRING HUNTING GROUND OF THE SMITH SOUND NATIVE

These are built larger than usual and with considerable care and lined with the summer tupic, for the Eskimos plan to remain here at least a month. The house is shown before the snow entrance has been added.

Photograph by Donald B. MacMillan

ROUGH ICE IN THE POLAR BASIN ABOUT ONE HUNDRED MILES DUE NORTHWEST OF AXEL HEIBERG LAND

An answer to the question why it has taken man more than three hundred years to reach farthest north.

Photograph from Rear Admiral Robert E. Peary

AN ESKIMO SEXTET ON THE MAIN DECK OF PEARY'S ARCTIC SHIP "ROOSEVELT"

"Let there be no doubt as to Peary's popularity in the Far North. Absolutely square and honest in all his dealings with these black-haired children of the Arctic, firm but ever just and kind in all his relations, he remains to them as the great 'Nalegak,' a leader or chief among men" (see text, page 305).

With the ever-repeated "Huk! Huk!" and the snapping of whips, men, dogs, and sledges were swallowed up in the rough sea ice. And again silence reigned along the shore, along the face of the cliff, and in and about the deserted snow village.

PEARY WITHIN 174 MILES OF HIS GOAL

All went well for a few days, which is but a friendly ruse of the Arctic to inspire confidence, and then it happened—a six-day blizzard, obliterating the trail, smashing up the ice of the Polar Sea, scattering and destroying caches of food, and driving all natives, white men, and dogs 60 miles to the east (see map, p. 297).

One by one the various divisions struggled shoreward; but Peary and his men, although knowing that no relief could be expected from the rear, that all food supplies were gone, deliberately turned their backs toward home and their faces toward their objective point and plodded on until they stood at the world's record of "Farthest North," 174 miles from the Pole.

Weeks later that tired little band climbed feebly up over the ice foot on the northern coast of Greenland, burned their last sledge for fuel, ate one of three dogs, and began their long walk back to the ship, frozen in the ice at Cape Sheridan. Within two weeks this indomitable man was heading west along the northern shores of Grant Land, in a thousand-mile trip to the northern shores of Axel Heiberg Island!

Such a journey immediately following such an experience in the Polar Sea was so improbable and apparently impossible so late in the year that many were inclined to doubt Peary's claim to have reached that distant point. Our finding of his record there in 1914* removes all doubt as to his achievement.

* See the records of the Donald B. MacMillan Arctic Expedition, 1913-1917.

Photograph from Rear Admiral Robert E. Peary

PEARY'S ARCTIC SHIP "ROOSEVELT" ICE-BOUND IN ROBESON CHANNEL

The *Roosevelt* was 184 feet long, 35.5 feet broad, 16.2 feet deep, with a gross registered tonnage of 614 tons. The frames of the hull were of oak; the planking was double, yellow pine inside and oak outside. Its engines developed 1,000 horse-power, driving a single eleven-foot propeller. In addition, it carried 14 sails, with a sail area somewhat less than that of a three-masted coasting schooner of the same size.

In 1906 Peary arrived in America, reporting that he had failed to reach the Pole, but declaring that he would make another and last attempt.

NO MISUNDERSTANDING ON THE PART OF PEARY'S ASSOCIATES

What young man with red blood wouldn't follow such a man and spend every ounce of his energy to help place him at the goal of his ambition? Not one who signed his contract in the old Grand Union Hotel in New York expected to go to the Pole; not a man went north for that purpose. Each wanted to do his little and that little his best to place Peary there. Such was our admiration for this great explorer. I write this in answer to the oft-repeated statement that Peary's men were very much disappointed in not being permitted to accompany their commander to his last camp.

We entered upon this enterprise with no misunderstanding. We knew what we were facing, for we had followed him in our reading for years. We knew that this was probably his last attempt, and that he might go beyond the limit of safety, but, if so, then we all wanted to be with him and were eager for the start.

As we steamed along the Labrador coast and out into the ice of Baffin Bay, we began to know our commander and were drawn strangely toward the man whom we recognized as one thoroughly versed in ice technique—a master of his profession. We often recalled the parting words of President Roosevelt at Oyster Bay: "Peary, I believe in you, and if it is possible for man to get there, I know you'll do it!"

We all had this same faith in the man, and now that we saw him in action, that faith was even strengthened.

Decks were cleared for our battle in

Photograph by Donald B. MacMillan

SOUTHERN SHORE OF HAKLUYT ISLAND, DISCOVERED BY BAFFIN IN 1616, BUT REMOVED FROM THE MAP FOR TWO HUNDRED YEARS BECAUSE GEOGRAPHERS DISTRUSTED HIS WORD

Upon the island there are many very old stone igloos and stone fox traps. William Baffin was one of the earliest of a long line of British navigators who sought in vain for a Northwest Passage to India. Sailing as pilot of the *Discovery* in 1616, he reached a point 300 miles farther north than his predecessor Davis, and for 236 years his farthest north (about 77° 45′), stood as a record in these seas. Baffin Bay is named in his honor. It was he who named Smith Sound, Jones Sound, and Lancaster Sound in honor of three of his distinguished patrons.

Photograph by Donald B. MacMillan

A REMINDER OF ONE OF THE GREATEST DISASTERS OF POLAR EXPLORATION: THE STEAMSHIP "FOX" (NOW A DERELICT AT DISCO, GREENLAND), COMMANDED BY CAPTAIN LEOPOLD M'CLINTOCK ON HIS SEARCH FOR SURVIVORS OF THE FRANKLIN EXPEDITION OF 1845

For twelve years following the disappearance of Sir John Franklin's party in the *Erebus* and the *Terror*, the British Government and Lady Franklin continued to dispatch expedition after expedition to find trace of the 129 officers and men who had set out to discover a Northwest Passage to the Pacific. M'Clintock's searching party sailed from Aberdeen, Scotland, in July, 1857, in this little yacht, purchased and fitted out by Lady Franklin with the last of her fortune. He finally brought back to civilization the story of the tragic fate which overtook the whole Franklin party.

THE ONLY MAN BESIDES ADMIRAL PEARY AND FOUR ESKIMOS WHO STOOD AT THE TOP OF THE WORLD

Matthew Henson, the expert colored assistant, had been with Peary since his second expedition to Nicaragua, in 1887, and on all his Arctic expeditions except the first, in 1886. The leader considered him the best dog-driver living, except some of the best of the Eskimo hunters themselves (see page 310).

Melville Bay. Holds were carefully restored; necessary food and equipment made readily accessible; boats supplied with provisions, rifles, and ammunition for a retreat following a possible loss of our ship, and all without a single *order* from the man who has been called tyrant and martinet. To us, his assistants, it was always: "I would like to have you do this"; "Some time today"; "Tomorrow will do," etc. We were amazed, for we did not expect such consideration. Kindness toward his men was apparent at every stage of our voyage.

Borup was summoned to Peary's cabin from the after hold, where he was miserably seasick but pluckily sticking to his job of packing away skins, with now and then a dash to the rail. He returned an hour later, enthusiastic over his visit and over the kindness shown him by the leader of the expedition.

PEARY REVERED BY THE ESKIMOS

Those happy days of wending our way northward in and out between floes and icebergs passed all too quickly. Finally that day arrived when we passed in under the big hills of Meteorite Island and heard the glad cry of those Far North natives upon beholding "Peary-ark-suah" (Big Peary) back again.

Let there be no doubt as to Peary's popularity in the Far North. Absolutely honest and square in all his dealings with these black-haired children of the Arctic, firm but ever just and kind in all his relations, he remains to them as the great "Nalegak," a leader or chief among men.

We can never forget this reception at Cape York—kayaks darting about the ship, the shouts of his former dog drivers, men who had starved with him on the Polar Sea, others on the shore standing at the water's edge ready to grasp the bow of our boat, women laughing, babies crying, and half-grown children with that look of mingled fear and animal curiosity.

How happy they were to see him back and how eagerly and how impatiently they awaited the word to pack their world's goods and transfer all to the deck of the *Roosevelt* for the long voyage northward.

And so it was at every village; the best men in the whole tribe awaited his call—a fact not without significance, in view of oft-repeated statements that Peary was unkind to his native help.

INTO THE HEAVY ICE

Some three weeks later, with decks almost awash and black and fuzzy with dogs and Eskimos, the saucy-looking *Roosevelt* swung around Sunrise Point and into the heavy ice of Smith Sound, her destination the northern shores of Grant Land, far up at the edge of the Polar Sea.

Behind us, upon the shores of Foulke Fiord, was a reserve of coal and food, to which Peary and his men could retreat if their ship was crushed. Such wise precaution was the result of his years of labor in the North and his repeated failures.

The successful negotiation of this last dangerous stretch Peary considered as the crucial link in the long chain of success. That no opportunity for advance should be lost was very evident from his almost constant vigil on the bridge, in the main rigging, or in the crow's nest.

Bartlett and Commander were a perfect team; the former young, intensely energetic, courageous; the latter experienced, cautious, of excellent judgment, constantly advising and holding his captain in check.

No braver man ever trod the quarter-deck than Bartlett. I sometimes think that Bob would rather lose his ship for the pure love of the fight southward in the drift-ice or in open boats than sail into port with his charge staunch, trim, and unscarred.

FARTHER NORTHWARD THAN ANY OTHER SHIP EVER STEAMED

Together they drove their ship farther northward than any other ship ever steamed. Boats were ready for immediate launching; food lined the rail; emergency bags were packed.

Once in our winter quarters, Peary again displayed his qualities of leadership by removing from the ship everything absolutely needed for the attainment of the Pole and the retreat southward, if the vessel should be crushed, carried away by the ice, or burned.

In spite of the loss of the *Roosevelt,*

Photograph by Donald B. MacMillan

THE WINTER HOME OF THE SMITH SOUND NATIVE, THE ROCK IGLOO

The sides are banked with sod, the roof is covered with grass and the summer tent, and lastly with snow, making a very comfortable habitation. Access is gained by a tunnel, some twelve feet in length, which leads to a hole in the floor. The window, which has the appearance of a large striped flag hung against the rocks, is made of the intestines of the seal or walrus. It is translucent, not transparent.

the work would have been carried out as planned. Even houses were built to shelter the large contingent of seventy-five men, women, and children.

MEN CONSTANTLY ON THE MOVE THROUGHOUT THE WINTER

With the Arctic night now coming on, the problem presented itself of how to preserve the health and happiness and good spirits until the time of our departure out over the ice of the Polar Sea, five months later.

At this stage of the battle many a leader has failed because he has not appreciated the full value of work, and necessarily *out-of-door* work, as shown by oft-repeated statement in books on the Arctic, such as: "No work can be done during the darkness of the Arctic win-

Photograph by Donald B. MacMillan

ESKIMO WOMEN AT ETAH CHEWING SKINS

The one on the left is chewing sealskin out of which she will make a pair of mittens. The one on the right is chewing a boot sole in order that she may pass the needle through it more readily and that it may be more comfortable to the foot.

ter"; "It is positively suicide to sledge during the winter," etc.

Peary laughed at such ideas. His men were away with crack of whip and laughter and enthusiasm almost as soon as our keel touched bottom at the edge of the Polar Sea, and they continued to come and go throughout the year, far into the interior of Grant Land, in quest of musk-oxen, caribou, and Arctic hare; for Peary, who never had a single case of scurvy on any of his expeditions, fully appreciated the value of fresh meat as an antiscorbutic.

Fresh vegetables, acids, and fruits are not necessary. This fact we have known for at least a half century, having acquired it from the experience of the American whaling captains when wintering on the shores of Baffin Land and Hudson Bay. Scurvy-stricken patients were always dispatched by them immediately to the igloos of the Eskimos, there to be restored to health by consuming raw frozen meat.

These excursions were not merely to keep us in good health and contentment; every move was directed toward the success of the expedition, geographically and scientifically. There were no schools between decks for the men, as in olden days; no weeks of preparation for farce or drama; no weekly or monthly periodical published; no roped promenade from berg to berg; no long hours in bed between meals.

We were either away with our dog teams among the mountains of Grant Land hunting reindeer, musk-oxen, or Arctic hare or were one hundred miles up or down the coast, living in snow houses, engaged in taking tidal observations, or at the ship working upon our equipment for the Polar dash.

If one word was written large upon the face of every man and upon the walls of every little stateroom in the steamship *Roosevelt,* it was the word *enthusiasm,* which may be translated into good leadership; for we felt our strength

Photograph by Donald B. MacMillan

AL-NING-WA, AGED TWENTY-TWO, WIFE OF ARKLIO, A DOG-DRIVER OF THE MAC MILLAN EXPEDITION, DRESSED IN BLUE-FOX SKINS

and our knowledge in Arctic matters increasing day by day and beheld an equipment being perfected which we knew must win.

Certain items were so far superior to anything yet devised for Arctic work that their value, even to a novice, was obvious. Such were perfected by Peary following years of repeated struggle.

PEARY DEVISED A NEW ARCTIC STOVE

Do not forget the great word *experience*. As an illustration, previous to the 1908 trip the most satisfactory stove for Arctic sledge-work was the so-called Primus, which converts cracked ice at 60 below zero into a gallon of tea in about 20 minutes. Peary reasoned that the more rapid his stove, the more sleep for his men at the end of the long march. He thereupon devised a stove which is so economical in fuel consumption and so quick in its action that many are almost inclined to doubt the fact that we had our gallon of tea in *nine* minutes from the time that the match was applied.

Our clothing, that of the Smith Sound Eskimo, could not be improved upon. Our food was amply sufficient for the maintenance of health and strength. Our sledges were modeled by Peary for the rough ice of the Polar Sea and skillfully fashioned by our master mechanic, Matt Henson. Our equipment was without a doubt the most nearly perfect yet devised for Polar work.

Peary's plan for advance and attack upon the Pole, based upon his experience and failure in 1906, was unique and a large factor in his final success.

From the time when one leaves the northern shores of Grant Land or Greenland, one must depend wholly upon the food on the sledges for sustenance of men and dogs. An occasional bear or seal might be secured, but such would be the exception, as proved by the experience of Nansen, Sverdrup, Captain Cagni, Peary, and every man who has been north of 84°.

To feed Peary and his men until he

Photograph by Donald B. MacMillan

SHOO-E-GING-WA, A LITTLE ESKIMO GIRL OF ETAH, AGED SEVEN

The Eskimo puppy-dogs are the common playthings of the Smith Sound children.

was within striking distance of the Pole and selfsupporting for the five hundred miles of the return trip was the work assigned to the so-called supporting parties under the command of Henson, Bartlett, Marvin, Borup, Goodsell, and myself.

Every five days a white man and his Eskimos were to return to land with an amount of food equal to one-half consumed in the outward trip, with orders to double march, and if held up by open water to eat the dogs. The work of this division was done; it was no longer needed in a task where one's life might depend upon ounces, not pounds; where every additional particle of food is a synonym for miles of travel, and where the last ounce might mean the last mile and success in one's life-work.

AN INSTANCE OF HEROIC SACRIFICE

In general, the American people have minimized the dangers of travel on the Polar Sea and have overestimated the narrow margin of safety of even a small party five hundred miles from land.

The presence of one man not absolutely needed in the work endangers the lives of all, for that man must be fed and must receive an equal amount of the last bite.

Do you remember the brave Oates, of

Photograph by Donald B. MacMillan

AK-KOM-MO-DING-WA EATING MEAT IN THE USUAL MANNER OF THE SMITH SOUND NATIVE

There are no plates and no forks; consequently the meat is grasped in the hand, shoved into the mouth, and cut off at the lips.

the Scott starvation party, who, realizing that his presence meant the loss of all, calmly remarked to his commander, "I am going out for a little while; I may not come back"?

With the dropping of the tent flap and the disappearing of that stumbling frost-bitten form into the swirling snows of the Antarctic ice-cap, there ended the most pathetic and the most heart-stirring scene ever enacted upon the stage of Polar work. All honor to such a hero!

Every white man realized what the success of this trip meant to Peary, and each man knew that the sooner he returned to land after he had finished his work, the better the chances of Peary reaching his goal.

When we heard the words, "You are to go back tomorrow," let me emphasize the fact that every man did so cheerfully and willingly, knowing that it was for the best interests of the expedition. No man expected to go at the start and no man complained at the finish.

Peary owed it to himself, to his friends, to his country, to rid himself of all encumbrances, of all superfluous material, and strip for action. It was his fight now, not ours; ours only just as long as we were needed.

And the negro? He was indispensable to Peary and of more real value than the combined services of all four white men. With years of experience equal to that of Peary himself, an expert dog-driver,

Photograph by Donald B. MacMillan

E-TOOKA-SHOO FINDING, AT CAPE ISABELLA, IN APRIL, 1917, THE MAIL LEFT BY SIR ALLEN YOUNG, OF THE "PANDORA," FOR THE BRITISH NORTH POLE EXPEDITION OF 1875-'76

The packet contained two letters for Captain Nares, of the *Alert,* and one letter for Captain Stephenson, of the *Discovery.*

a master mechanic, physically strong, most popular with the Eskimos, talking the language like a native, clean full of grit, he went to the Pole with Peary because he was easily the most efficient of all Peary's assistants (see page 304).

UNREASONABLE DOUBT CAUSED BY PEARY'S SPEED

Weeks later the little band of six returned, clearly revealing the terrible strain and anxiety during that rapid dash to land over ice fields which threatened to be rent asunder by the high tides of the approaching full moon. In fact, the work was *too* well done, as many a doubt as to Peary's achievement was based upon the time of his return.

During the days of that most unfortunate controversy enough consideration was not given by the public to the following all-important facts:

Photograph by Donald B. MacMillan

A POLAR BEAR HELD AT BAY BY THE DOGS UNTIL THEIR MASTERS ARRIVE

The polar bear has been called the tiger of the North, but, according to Peary, a contest between one or two, or even three, of these animals and a man armed with a Winchester repeating rifle is an entirely one-sided affair. On the contrary, a contest with a herd of walrus—the lions of the North—in a small whale-boat will give more thrills to the minute than anything else within the Arctic Circle.

Photograph by Donald B. MacMillan

KA-KO-TCHÉE-A FEEDING MAC MILLAN'S TEAM AT ETAH, NORTH GREENLAND

On Arctic expeditions walrus are hunted for the purpose of obtaining the maximum of meat for dog food in the minimum of time.

Photograph by Donald B. MacMillan

A LARGE HERD OF MUSK-OXEN ON THE FORSHEIM PENINSULA

A single musk-ox when pursued by dogs will make for the nearest cliff and get his back against it, but a herd will round up in the middle of a plain, with tails together and horns toward the enemy. Then the bull leader will take his place outside the round-up and charge the dogs. When the leader is shot another takes his place.

First. Peary's supporting parties placed him at nearly the 88th parallel.

Second. The observations at this point were taken and signed by Captain Bartlett, of the *Roosevelt.*

Third. From this point on Peary had five well-provisioned sledges, five of the best men of 25, 48 of the best dogs of 250, and only 120 miles to go.

Fourth. The trail to land was well marked and broken ends knit together by the retreat of the various divisions.

Fifth. All expeditions for a half century have double-marched and even triple-marched on the return trip.

How often have I heard the assertion that Peary told none of his men that he had reached the Pole until he learned of Dr. Cook's attainment! Far up on the northern shores of Grant Land, at the edge of the Polar Sea, there stands a cairn, Peary's announcement of the attainment of his life's work, built there *twelve weeks* before we reached civilization. He did not forget his men. The names not only of his assistants, but of every man on board the *Roosevelt,* are written there and placed under glass as a protection against the weather.

PEARY DELAYS NEWS OF HIS TRIUMPH IN ORDER TO HELP ESKIMOS

Upon our arrival at Etah, several weeks later, Dr. Cook's two Eskimo dog drivers, E-took-a-shoo and Ah-pellah, came on board and told us that in company with Cook they had been living down in Jones Sound for nearly a year, and that at no time had they been farther north than a spot which they indicated on the map close to the northern shores of Axel Heiberg Land, distant 500 miles from the Pole.

Naturally eager to steam southward to proclaim to the world the news of his discovery after so

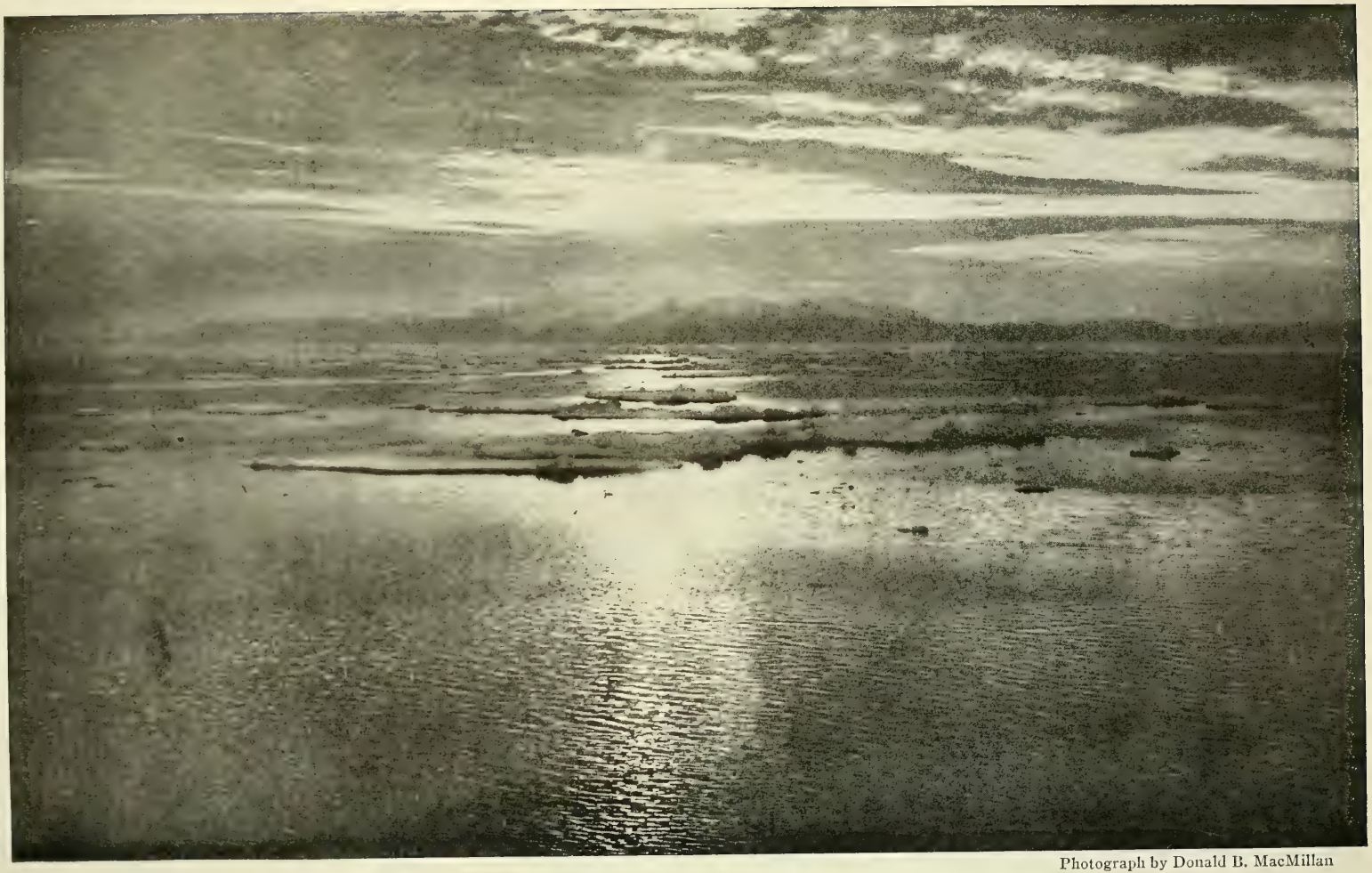
Photograph by Donald B. MacMillan

THE HEAD OF A BULL WALRUS KILLED AT ETAH, GREENLAND

The Atlantic walrus is not as large as the Pacific, but specimens have been secured in Smith Sound weighing 3,000 pounds. On a walrus hunt, which is the most dangerous sport in the Arctic regions, the whale-boats are painted white to resemble pieces of ice, and the rowlocks are muffled, to enable the hunters to steal upon their quarry without detection.

many years of hardship, yet Peary felt that his first duty was toward his Eskimos, those natives who made it possible for him to win out. And there we remained, killing walrus and supplying them with food for the long winter night to come, while Cook was wearing roses and being fêted by kings and queens.

Peary's attitude upon reaching the Labrador coast has been grossly misunderstood. Not only did he not mention his rival's name in his first telegrams, but expressly requested us to refrain from doing so; and this in view of the fact that he knew that an impostor was being proclaimed as the real discoverer. He was not, however, to be permitted to retain this rôle of stoic.



Photograph by Donald B. MacMillan

CLOUD AND SUN EFFECT AT ABOUT ELEVEN O'CLOCK AT NIGHT OVER CAPE SABINE

We steamed southward from Indian Harbor, and upon our arrival at Battle Harbor our Commander was met by a flood of telegrams from the press and from various geographical and scientific societies at home and abroad, all requesting that he give them his honest opinion as to Dr. Cook's achievement.

What should he do?

At this crucial point in his career the average man believes that Peary failed. But the average man has not slept with his back against a sledge at fifty and sixty degrees below zero, with biting winds whipping the snow over his body, dead tired with the day's work; has not crossed treacherous black ice on snow-shoes; has not staggered back beaten to his little hut, followed by one shadow—of a dog; has not returned to home, family, and friends year after year with the one word failure on his lips; has not in the flush of victory seen an impostor bowing to the plaudits of the multitude.

Was his one public telegram in answer to urgent requests too severe in condemnation of one whose claims have since been discredited by every scientific society in the world: "Dr. Cook has handed the people a gold brick. When he claims to have discovered the Pole over his own signature, I shall have something decidedly interesting to say"?

Peary could have shifted the responsibility for that answer upon Captain Bartlett or any of his assistants; but all who know Peary know that the thought of doing so never entered his mind, as he restlessly paced the floor of his little cabin in that northern port.

That bitter controversy is dismissed today with "most unfortunate"!

As we steamed southward on our last lap with this great explorer, we often reviewed the year that had gone so quickly, and our relations with our leader, all so pleasant.

Ever kind and thoughtful and considerate of his young and inexperienced men, he treated them as a father would treat his sons. He helped us lash and pack our sledges, untangled and repaired our frozen and knotted traces.

When struggling along far in the rear, with refractory dogs and heavy loads, an Eskimo would often be detailed to relieve us of a part of our load and pilot us safely across an open lead, and if we arrived with frost-bitten face, it was often the Commander's warm hand that brought the blood back to the surface.

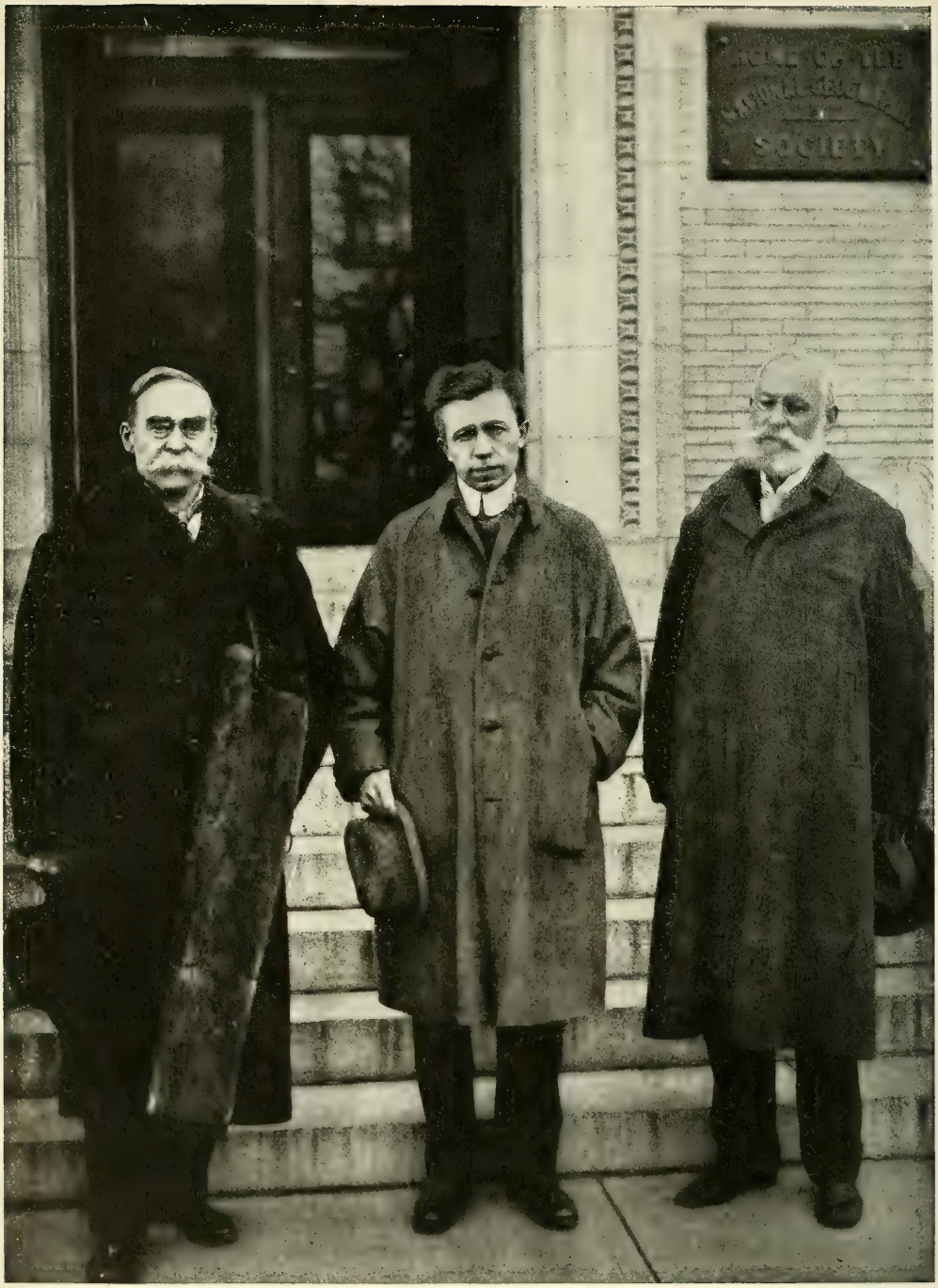
SOLICITUDE FOR HIS ASSOCIATES' WELFARE ONE OF PEARY'S NOTEWORTHY TRAITS

I well remember falling through the ice at 59 below zero. With sealskin boots filled with water and rapidly stiffening clothes, I arrived at our encampment of snow houses. He beat the ice from my bearskin pants, pulled off my boots, and wiped my feet and legs with the inside of his warm shirt. And when covered with blood, a heavy 40-82 bullet having passed through my arm, into my shoulder, and out through the back, and clipping the side of one finger, he remarked: "I would much rather had that thing happen to me than to you!"

This does not sound like "martinet" or "tyrant" or "unkind to his men." His last words to Marvin, lost on the return, "Be careful of the leads, my boy," is characteristic of the man.

Is it any wonder, then, that we as assistants, when we heard the blowing of the whistles of Sydney, N. S.; beheld the line of craft circling out to escort us into the harbor; saw waving flags and docks black with people, should be almost sorry that he had won out?

We knew that never again would we have the honor and the pleasure of serving under such a leader.



Photograph by Charles Martin

PEARY, STEFANSSON, AND GREELY, A TRIUMVIRATE IN POLAR EXPLORATION ACHIEVEMENT

This photograph, made at the Washington headquarters of the National Geographic Society in January, 1919, was the last taken of Rear-Admiral Peary, discoverer of the North Pole, who stands at the left. In the center is Vilhjalmur Stefansson, who had just been awarded The Society's Hubbard Gold Medal for his work in adding 100,000 square miles to the mapped Polar regions of the Western Hemisphere. At the right is Major-General A. W. Greely, leader of the Greely International Polar Expedition of 1881-'84.

PEARY'S EXPLORATIONS IN THE FAR NORTH

By Gilbert Grosvenor

President of the National Geographic Society

THE struggle for the North Pole began nearly one hundred years before the landing of the Pilgrim Fathers at Plymouth Rock, being inaugurated (1527) by that king of many distinctions, Henry VIII of England.

Scores of hardy navigators—British, French, Dutch, German, Scandinavian, and Russian—followed Davis, all seeking to hew across the Pole the much-coveted short route to China and the Indies. The rivalry was keen and costly in lives, ships, and treasures; but from the time of Henry VIII for three and one-half centuries, or until 1882 (with the exception of 1594-1606, when, through William Barents, the Dutch held the record), Great Britain's flag was always waving nearest the top of the globe.*

Immense treasures of money and lives were expended by the nations to explore the northern ice world and to attain the apex of the earth; but all efforts to reach the Pole had failed, notwithstanding the unlimited sacrifice of gold and energy and blood which had been poured out without stint for nearly four centuries.

PEARY'S INTEREST IN THE ARCTIC AWAKENED IN 1886

A brief summer excursion to Greenland in 1886 aroused Robert E. Peary, a civil engineer in the United States Navy, to an interest in the Polar problem. Peary a few years previously had been graduated from Bowdoin College second in his class—a position which means unusual mental vigor in an institution which is noted for the fine scholarship and intellect of its alumni. He realized at once that the goal which had eluded so many hundreds of ambitious and dauntless men could be won only by a new method of attack.

The first Arctic problem with which Peary grappled was considered at that time in importance second only to the conquest of the Pole, namely, to determine the insularity of Greenland and the extent of its projection northward. At the very beginning of his first expedition to Greenland, in 1891, he suffered an accident which sorely taxed his patience as well as his body, and which is mentioned here as it illustrates the grit and stamina of his moral and physical make-up.

As his ship, the *Kite,* was working its way through the ice fields off the Greenland shore, a cake of ice became wedged in the rudder, causing the wheel to reverse. One of the spokes jammed Peary's leg against the casement, making it impossible to extricate himself until both bones of the leg were broken.

The party urged him to return to the United States for the winter and to resume his exploration the following year; but Peary insisted on being landed, as originally planned, at McCormick Bay, stating that the money of his friends had been invested in the project, and that he must "make good" to them.

The assiduous nursing of Mrs. Peary, aided by the bracing air, so speedily restored his strength that at the ensuing Christmas festivities which were arranged for the Eskimos he outraced on snowshoes all the natives and his own men!

HE ASCENDS THE GREENLAND ICE-CAP

In the following May, with one companion, Astrup, he ascended to the summit of the great ice-cap which covers the interior of Greenland, 5,000 to 8,000 feet in elevation, and pushed northward for 500 miles over a region where the foot of man had never trod before, in temperatures ranging from 10 degrees to 50 degrees below zero. Imagine his surprise on descending from the table-land to enter a little valley radiant with gorgeous flowers and alive with murmuring bees, where musk-oxen were lazily browsing.

This sledding journey, which he dupli-

* In 1882 Lockwood and Brainard, of Greely's expedition, won the record of Farthest North for the United States, and we held it until Nansen's feat of 1896.

© Harris and Ewing

THE DISCOVERER OF THE NORTH POLE GREETING THE DISCOVERER OF THE SOUTH POLE AT A NATIONAL GEOGRAPHIC SOCIETY BANQUET

It was upon this occasion that Rear-Admiral Peary, on behalf of The Society, presented to Captain Roald Amundsen a special gold medal for his Antarctic achievement resulting in the attainment of the South Pole. Mrs. Peary at extreme left, Ambassador James Bryce at right of Peary, and Ambassador Jusserand at extreme right.

cated by another equally remarkable, crossing of the ice-cap, three years later, defined the northern extension of Greenland and conclusively proved that it is an island instead of a continent extending to the Pole. In boldness of conception and brilliancy of results, these two crossings of Greenland are unsurpassed in Arctic history. The magnitude of Peary's feat is better appreciated when it is recalled that Nansen's historic crossing of the island was below the Arctic Circle, 1,000 miles south of Peary's latitude, where Greenland is some 250 miles wide.

HE TURNS HIS ATTENTION TO THE POLE

Peary now turned his attention to the Pole, which lay 396 geographical miles farther north than any man had penetrated on the Western Hemisphere. To get there by the American route he must break a virgin trail every mile north from Greely's 83° 24′. No one had pioneered so great a distance northward. Markham and others had attained enduring fame by advancing the flag considerably less than 100 miles, Parry had pioneered 150 miles, and Nansen 128 from his ship.

His experiences in Greenland had convinced Peary, if possible more firmly than before, that the only way of surmounting this last and most formidable barrier was to adopt the manner of life, the food, the snow houses, and the clothing of the Eskimos, who by centuries of experience had learned the most effective method of combating the rigors of Arctic weather; to utilize the game of the Northland, the

Arctic reindeer, musk-ox, etc., which his explorations had proved comparatively abundant, thus with fresh meat keeping his men fit and good-tempered through the depressing winter night; and, lastly, to train the Eskimo to become his sledging crew.

In his first North Polar expedition, which lasted for four years, 1898-1902, Peary failed to get nearer than 343 miles to the Pole. Each successive year dense packs of ice blocked the passage to the Polar Ocean, compelling him to make his base approximately 700 miles from the Pole, or 200 miles south of the headquarters of Nares, too great a distance from the goal to be overcome in one short season. During this trying period, by sledging feats which in distance and physical obstacles overcome exceeded the extraordinary records made in Greenland, he explored and mapped thousands of miles of coast line of Greenland and of the islands west and north of Greenland.

ADMIRAL PEARY'S PHOTOGRAPH OF THE NORTH POLE

The northern axis of the globe is in the midst of a vast Polar Sea, and the mound of the photograph is a mere mass of snow and ice utilized by Peary as a pinnacle for the American flag which floats at the top. On his return journey, five miles from the Pole, the explorer came upon a narrow crack in the ice, through which he attempted a sounding. The length of his apparatus was 9,000 feet, but the lead did not strike bottom. So, the depth of the sea at the Pole is still undetermined.

PEARY LED HUNDREDS INTO THE ARCTIC WITH ONLY TWO TRAGIC ACCIDENTS

On the next attempt Peary insured reaching the Polar Ocean by designing and constructing the *Roosevelt,* whose resistless frame crushed its way to the desired haven on the shores of the Polar sea. From here he made that wonderful march of 1906 to 87° 6′, a new world's record. Winds of unusual fury, by opening big leads, robbed him of the Pole and nearly of his life.

The last Peary expedition, 1908-1909, resulted in the discovery of the Pole and of the deep ocean surrounding it. The 396 miles from Greely's farthest had been vanquished as follows: 1900, 30 miles; 1902, 23 miles; 1906, 169 miles; 1909, 174 miles.

No better proof of the minute care with which every campaign was prearranged can be given than the fact that, though Peary has taken hundreds of men north with him on his various expeditions, he has brought them all back, and in good health, with the exception of two, who lost their lives in accidents for which the leader was in no wise responsible. What a contrast this record is to the long list of fatalities from disease, frost, shipwreck, and starvation which in the popular mind has made the word arctic synonymous with tragedy and death.

THE PRIZE OF FOUR CENTURIES IS HIS REWARD

Thus Robert E. Peary crowned a life devoted to the exploration of the icy North and to the advancement of science by the hard-won discovery of the North Pole. The prize of four centuries of striving yielded at last to the most persistent and scientific attack ever waged against it. Peary's success was made possible by long experience, which gave him a thorough knowledge of the difficulties to be overcome, and by an unusual combination of mental and phy-

sical power—a resourcefulness which enabled him to find a way to surmount all obstacles, a tenacity and courage which knew no defeat, and a physical endowment such as Nature gives to few men.

It has been well said that the glory of Peary's achievement belongs to the world and is shared by all mankind. But we, his fellow-countrymen, who have known how he struggled those many years against discouragement and scoffing and how he persevered under financial burdens that would have crushed less stalwart shoulders, especially rejoice that he "made good at last," and that an American has become the peer of Hudson, Magellan, and Columbus.*

PEARY'S ASSOCIATION WITH THE NATIONAL GEOGRAPHIC SOCIETY

Peary's first address to the National Geographic Society was in the fall of 1888, when The Society was only a few months old. He then described an expedition which he had led across Nicaragua. He was actively associated with its work ever since those early days, and on his return from each of his expeditions to the Far North, his first public address was to the National Geographic Society. His last public appearance was on the platform of the National Geographic Society when in January, 1919, he introduced Stefansson, who had just returned from the Canadian North.

It was at a National Geographic Society meeting in 1907 that he was presented the Hubbard Gold Medal of The Society by President Roosevelt, and in 1909 a Special Gold Medal for his discovery of the North Pole, and later he became a member of its Board of Managers.

It was my privilege to know Admiral Peary intimately for twenty years, and I find it difficult to express my admiration and affection for his personal qualities, the bigness of his heart and personality, his loyal devotion to his friends, his generous enthusiasm at real accomplishment by others in any field, his rugged integrity, and his love for everything American.

As long as the National Geographic Society lives, its members can take pride in the fact that the organization did its utmost to help Peary "nail the Stars and Stripes to the Pole."

THE CROW, BIRD CITIZEN OF EVERY LAND

A Feathered Rogue Who Has Many Fascinating Traits and Many Admirable Qualities Despite His Marauding Propensities

By E. R. Kalmbach

Assistant Biologist, U. S. Biological Survey

OUR American crows, with all their thousands, comprise but a small contingent of the corvine hordes that are to be found in one form or another in almost every inhabitable land. Crows are present throughout a large part of the North American Continent, the tundras of Siberia, in the thickly settled valleys of central Europe, along the shores of the Mediterranean, in Africa, India, China, Japan, throughout many of the islands of the Eastern archipelagoes, as well as on that biologically unique continent of Australia.

South America alone seems to be devoid of representatives of that group of birds classified as crows and ravens.

It is true this host is composed of a great number of different species, mainly black fellows, and frequently with reputations appropriately associated with such a garb; but, with all its species, this group of birds is a wonderfully distinct one.

These royal rogues, like clannish races

* The preceding paragraphs are extracted from a brief history of North Polar explorations written by Gilbert Grosvenor for the Foreword of Admiral Peary's book, "The North Pole" (F. A. Stokes Company).

or certain religious sects, have to a remarkable degree preserved their odd mannerisms through many ages. Their bold sagacity and, above all, their ability to eke out a living in environments that Nature seems to have neglected have stood them in good stead in their struggle for existence. Be it a raven, or jackdaw, chough, rook, or crow, its corvine attributes are at once recognizable.

Each of the species has peculiarities all its own, but the characteristics that are common to all, the family marks of recognition, are the ones that readily appeal to any one, and have resulted in the crows and ravens holding a distinctive place in bird lore.

A SUBJECT FOR POETS, FABULISTS, AND MEN OF SCIENCE

Probably more has been written of crows and ravens than any other group of birds. From ancient myth and fable to the poetry and prose of modern times, literature is replete with allusions to them.

In this article the author will endeavor to present, in a way understandable to all, some of the principal findings of his investigation of the food habits of our crows, the full results of which were published as Department Bulletin 621 of the U. S. Department of Agriculture—"The Crow and its Relation to Man."

The preparation of this bulletin entailed the examination of the stomachs of more than 2,100 crows from all parts of the bird's range, supplemented by field observations of many able ornithologists and practical farmers. A period of about five years, with some interruptions, was consumed in stomach examinations alone, using the best of laboratory equipment, including extensive collections of insects, crustaceans, mollusks, vertebrates, seeds, and other possible food items for comparison, and with the collaboration of specialists in the different groups.

Future days may bring about changes in the relative abundance of crows, in the character of crops raised, or even in the feeding habits of the birds themselves, but while present conditions prevail the results of this investigation must be looked upon as authentic (see page 331).

To most people a crow is a crow, and few realize that within the borders of the United States there are no less than nine different forms of corvine birds. Three of these are ravens and six are crows.

At least four of the six recognized forms of crows present in the United States are simply geographical races of the one species, the common crow, differing chiefly in the dimensions of the wing, tail, and bill, and in any treatment of the subject outside of the naturalist's cloister may well be considered as one. In food habits, and hence in economic significance, the members of these four races are as much alike as the varying food in their respective ranges permits. Another form, inhabiting the coastal region from Puget Sound to Alaska, is by some authorities also considered a geographic race, but in food habits this bird, the northwest crow, is quite distinctive.

The combined breeding ranges of these five races give a distribution to the common crow that extends to the North nearly to the Arctic Circle, throughout northern Manitoba, Ontario, central Quebec, and eastward into Newfoundland. It is found all along our Atlantic seaboard, well down into the peninsula of Florida, and throughout the Mississippi Valley, south to the Gulf coast. In the West crows are found locally in California and abundantly in Washington and Oregon—in diminishing numbers north to Alaska. Throughout the Rocky Mountain area and the arid regions of the Southwest they are not common.

In addition to the widely distributed common crow, there is one other form, quite distinct from it in food habits and economic influence, the fish-crow of the South Atlantic and Gulf coasts. While something is known of the food preferences of this odd maritime species, a full appreciation of its economic influence is dependent on more extensive laboratory and field work.

CROWS ARE MODEL PARENTS

The home life of crows is very orderly and need hardly be mentioned. As parents, they are models in the avian world. The nest, which is well concealed from below during the breeding season, is placed at heights varying from 20 to 60 feet. Here are laid from three to seven eggs, which in our Southern States may

Photograph by William L. Finley and H. T. Bohlman

THE THEME OF POETS, FABULISTS, AND MEN OF SCIENCE

The crow is equally at home throughout the continent of North America, in the tundras of Siberia, along the shores of the Mediterranean, in Africa, India, China, Japan, and on many of the islands of the Eastern archipelagoes. South America alone knows him not.

be found as early as the end of February. Young crows may be found from the middle of March, in the South, to as late as July along our northern border.

The voracious young remain in the nest for about three weeks, and even after they learn to fly are fed to some extent by their parents. Throughout July and August crows may be found in family parties or in small flocks, living comfortably on a commendable diet into which enters a variety of insects, though the annual crop of grain furnishes a portion of the subsistence.

MIGRATION BEGINS IN SEPTEMBER

By September, however, begins the fall migration, and associated with it the establishing of crow roosts, by all odds the most interesting phenomena connected with these birds.

From September to March of each year the migratory habits of these birds bring together in two comparatively small areas the bulk of the crow population of North America. One of these nuclei is located east of the Alleghanies, with its center in the lower Delaware Valley; the other centers about the junction of the Ohio and Mississippi rivers. The western concentration, however, covers a much larger area, and roosts of enormous size may be found as far south as Oklahoma.

In the Far West there is also a condensation of the crow population in the winter months, particularly along the Columbia River and near the coast, but the number of birds involved is in no way comparable to the mammoth gatherings farther east.

While these clannish birds may be noted gathering in colonies of as many as several hundred in northern localities in August and September, it is not until about the first of October that the large conclaves in the latitude of Washington, D. C., begin to take on the aspect of their winter popularity. There is considerable fluctuation in numbers from day to day, and in periods of mild weather a roost previously established may wholly disappear.

Photograph by William L. Finley and H. T. Bohlman

A MOTHER CROW AT THE NEST EDGE

The nestling crow is one of the most voracious members of the animal kingdom. Most of its "growing pains" are in its stomach, and one baby bird consumes from eight to ten ounces of food every day (see chart, page 335).

In late January these nightly congregations reach their greatest size, and by the first of March the birds are well on the northward journey to their breeding grounds.

REMARKABLE CROW CITIES IN WINTER

Words fail to describe adequately to one who has never witnessed it the nightly gathering at a large winter roost of crows. I consider such congregations the most remarkable ornithological phenomena that in this day and age can still be witnessed in the thickly settled sections of our country (see page 328).

And, strange to relate, an extremely small part of the populace realizes the significance of those seemingly endless streams of black forms passing twice daily to and from the roosts, sometimes directly over thickly settled metropolitan sections. Fewer still have any conception of the countless thousands that gather at the hub of the converging streams. Mention of the numbers estimated at several of the better-known roosts may give some impression of the immensity of these conclaves.

One of the most notable roosts was that formerly located at Arlington, Va., where at the height of its occupancy from 150,000 to 200,000 crows gathered nightly.

The so-called "Arbutus" roost, near Baltimore, Md., contained in 1888 about 200,000 birds. At about the same time one or more roosts in the vicinity of St. Louis, Mo., harbored from 70,000 to 90,000 crows, and the one at Peru, Nebr., had from 100,000 to 200,000. Other roosts in which it was estimated the individuals aggregated more than 100,000 were formerly located at Hainesport, Merchantville, Bridgeboro, and Centerton, N. J., and on Reedy Island, in the Delaware River.

Some of these roosts, or their successors near by, still shelter many thousands of birds, although I am inclined to believe that in the East the crow roosts are becoming smaller. But the total num-

Photograph by William L. Finley and H. T. Bohlman

THE DINNER CALL

Grasshoppers, mice, May beetles, mollusks, frogs, caterpillars, and a score of other crow dainties are required to sate the appetite of this inordinate young feaster.

ber of these birds appears to be about the same. In the winter of 1910-1911 a roost near Woodridge, D. C., which appears to have been the successor to the Arlington roost, was estimated to contain 270,000, while in 1914 only about 30,000 birds could be accounted for.

There is evidence that leads one to think that in parts of Oklahoma some of the roosts have increased materially within recent years—a situation that may have been brought about by the increasing acreage of sorghum in that section, as this grain serves as an admirable winter food for these birds. Absolutely no credence, however, need be given to reports, which at times have had wide circulation, of roosts totaling "millions of birds."

Crow roosts are usually located in sparsely settled sections, but with the constant encroachment of man on virgin tracts the bird has found it increasingly difficult to find its former seclusion. Even in face of this, the crow maintains its interesting roosting habit, with the result that now we may witness this phenomenon in places readily accessible.

FAMOUS CROW COLONIES NEAR WASHINGTON

In the winter of 1912-1913 several thousand crows established a roost northwest of Washington within a few hundred feet of the Connecticut Avenue Boulevard, where trolley cars and automobiles passed every few minutes throughout the night.

The former location of the Woodridge roost, northeast of the National Capital, was in a small strip of Virginia pines near the station of Rives, on the Baltimore and Ohio Railroad. The passing trains caused no end of uproar while the clans were assembling, but when darkness came they paid little attention to the noise.

The present location of the Woodridge roost, while in a more secluded place than formerly, is still readily accessible and forms an important attraction to the bird-lovers of Washington. Just south of the Bladensburg road and at a point about one-third of a mile northeast of the Pennsylvania Railroad bridge lies a tract of woodland that extends in a long narrow strip to the south.

At the southern end there is still much

of the virgin stand left, but throughout most of this stretch a more or less mutilated second growth furnishes the nightly abode for many thousands of crows. Here, thanks to regulations prohibiting hunting in this part of the District of Columbia, the birds have found a fair measure of safety, though at times adventurous boys or thoughtless adults cannot resist the temptation to shoot up the roost.

Time will come when the clearing of this land will drive the birds away, but until then let us hope the Woodridge crows may continue unmolested their wonderful winter performance.

BIRD ASSASSINS RAID THE ROOSTS

At the roosts, where some conclude crows gather for mutual protection from enemies, the mortality is often high. Here the great horned owl wreaks cruel vengeance for the mobbing it receives at their hands in daylight hours, and the gaunt specter of disease at times stalks through their ranks.

A malady that has been erroneously termed roup leaves in its wake a certain toll every winter, and, when it appears in virulent form, the occupants of large roosts may be practically exterminated. This disease, affecting the mucous membranes of the throat and nostrils, also causes a whitish, translucent film to form over the eyes. Blindness follows, and I have seen hapless victims groping along the branch upon which they stood, apparently in a vain search for food.

Under the rigors of the disease, with gradual starvation sapping their strength, and with the relentless elements making suffering more intense, these unfortunates may succumb by the thousands in the course of a few weeks (see p. 330).

HOW THE MIGHTY FLOCK ASSEMBLES

The assemblage of one of these mighty concourses is a sight that will move even the least impressionable, and it never loses its grandeur by repetition. Scores of times have I watched the gathering hosts at the Woodridge roost; but the sight is no less appealing today than it was on the occasion when I first observed it. Essentially the procedure is the same from day to day, but, like a crackling fire or the battle of the surf, never becomes monotonous.

Photograph from H. M. Stowe

"A CROWS' ROOST"

As a pet the crow provides endless entertainment and not a little worry, for the bird is mischievous, ubiquitous, and resourceful.

Like a human rabble, these mighty flocks always seem to have their moods. There are clear days, with the birds flying high, when all appear festive bound; there are short days with leaden skies, when sullenness pervades; and there are tragic days—days with deep snow and high winds, when the spirit of grim determination alone brings back to the roost those that the elements have spared.

The battle for existence in the short days of January and February is indeed a cruel one for the crow; and when I see it in endless thousands engaged in a life-and-death struggle against the elements, starvation, disease, and even man himself, and it persists in fighting the battle on the same lines as its ancestors

Official photograph U. S. Biological Survey

ROOSTING CROWS (SEE PAGE 325)

Few sights in the bird world equal in impressiveness the assemblage of a large crow roost. This photograph was taken after sundown, with an exposure of several minutes, at the Woodridge roost, near Washington, D. C. The air was filled with flying birds, but only those that remained stationary for the greater part of the exposure made a conspicuous photographic impression.

fought centuries before, that black specter ceases to be a mere bird. It becomes the embodiment of a courageous spirit, living true to a cherished tradition. It is then that I admire the bird.

THE PERSONALITY OF THE CROW

The old adage, that familarity breeds contempt, has no place in a consideration of the relation between the crow and man. Undue familiarity with crops, wild birds, and poultry on the part of the crow has resulted in opinions regarding it that are far from complimentary; but I have never heard any one, even a confirmed enemy of the bird, refer to it in words of utter contempt. More intimate acquaintance may increase antagonism, but with it grows apace a greater appreciation of the crow's resourcefulness.

Notwithstanding that in the wild state it constantly avoids close association with man, the crow, when captured as a nestling, readily lends itself to domestication and, as a pet, reveals many fascinating traits.

I know of no bird that will furnish such an endless variety of entertainment, and, I may add, as much trouble, as a pet crow. They may be taught to utter a few words of articulate speech, but this is frequently interspersed with a choice assortment of ordinary corvine jargon that at times borders on the ridiculous. To perfect a crow in this respect, continuous association with the bird and infinite patience are necessary. The splitting of the tongue, so frequently recommended, adds nothing to the crow's ability as a linguist.

The intensity of corvine curiosity is almost feminine, and, if given a few trinkets, a pet crow will find no end of amusement.

Above all, crows are notorious thieves and hoarders, and if permitted the freedom of the dooryard will establish numerous caches of treasure.

I distinctly recall a friend's pet crow that, by its confiding nature, had earned an affectionate place in the household. The bird was always interested in garden operations, and when work was being done in the flower beds was sure to be present. One summer morning found its mistress busily engaged in weeding an aster bed. The refuse had been carefully raked into neat piles between the rows when a telephone call took her away for a moment, and in the brief absence the crow, that no doubt had been paying some attention to the operations, completed the job by pulling up the asters and depositing them in equally neat piles beside the refuse.

Another crow, whose plant-pulling proclivities had been developed almost to the point of an obsession with respect to a certain potted geranium, is the subject of a story once told by Mr. Robert Ridgway, the eminent ornithologist. This crow persisted in removing a particular plant, despite all that Mrs. Ridgway could do to keep it growing.

On one occasion the bird was observed busily engaged in grubbing for insects in the garden. It suddenly ceased its diligent search, paused for a moment with its head alert, then proceeded, half hopping, half flying, through the garden, the gate, and up the back stairs, directly to the doomed geranium, which was straightway pulled up and deposited neatly beside the pot. This done, the bird returned to its place in the garden and continued its methodical search for grubs.

Official photograph U. S. Biological Survey

THE GAUNT SPECTER OF DISEASE AT TIMES STALKS THROUGH THE RANKS OF CROW ASSEMBLAGES

This disease, affecting the mucous membranes of the throat and nostrils, also causes a whitish, translucent film to form over the eyes. Blindness follows; then these hapless creatures may be seen groping along the branches of trees, apparently in a vain search for food (see page 330).

DOG AND CROW, BOON PLAYMATES

Dr. Ned Dearborn has related an interesting story of a crow and a farmer's dog that grew up together. The dog enjoyed chasing sticks and stones, and it remained for the observant crow to evolve a plan for mutual amusement. The fracas would usually start whenever the crow found the dog enjoying a noon-

Photograph by Prof. E. H. Eaton

THE DEATH TOLL OF A SINGLE NIGHT AT A CROW'S ROOST

In December, 1901, the crows of Ontario County, New York, suffered severely from a malady erroneously termed roup. In the illustration are the bodies of 73 dead crows, photographed where they fell, in an area about 150 feet in diameter (see page 327).

day snooze. Finding a stick of convenient size, the bird would approach the dog, lay it down within easy reach, and then give its canine friend a nip or two on the heels.

As the startled dog awoke, the crow would grasp the stick in its bill and, flying about four feet from the ground, would start across the fields with the dog in hot pursuit. This continued until both had reached the point of exhaustion; whereupon each would return to its respective place of rest, the dog on the door-step and the bird on a nearby shed.

Mr. Nelson Wood, of the U. S. National Museum, who has had extensive experience with domesticated crows, several of which developed the power of speech to a remarkable degree, tells many interesting anecdotes of these birds. One, whose cage extended over the top of an inclined cellar door, once discovered that the cover of a baking-powder can with which it had been playing would readily slide down this incline. After experimenting with this toy for some time in various ways, it accidentally stepped into it while at the top of the incline. That was enough. Thereafter this avian "shoot-the-chute" furnished no end of amusement for both bird and spectators.

A CROW'S REVENGE

Another pet, whose linguistic powers were above the average, would increase its range of tone by thrusting its head into a tin can and there give vent to its thoughts. The activities of this same bird form the basis of an incident which I hesitate to construe as a manifestation of corvine strategy and desire for revenge, but an imaginative mind might so interpret the circumstances. It nevertheless makes a good story.

"Jack" had been severely reprimanded and, I believe, punished for alleged offenses in a neighbor's cabbage patch. These cabbages were choice plants—a fact that even "Jack" seemed to appreciate after he had been taken to task, as

thereafter an overhanging tree was his nearest approach to the patch.

For a week or more the cabbages prospered wonderfully, but one day, as the neighbor was busily engaged in his cellar, he heard coming from the patch a "swish, swish" that strongly suggested the tearing of cabbage leaves. On rushing to the door he beheld "Jack," flying a few feet from the ground and with leisurely wing beats traveling up and down the rows. Behind him, in mad pursuit and with utter disregard for his master's prize cabbages, was the neighbor's own dog.

Another exasperating trick, but one that seems to reveal the crow's love of pure devilment, is related by Mr. Wood, and I believe the account of a similar incident has appeared in literature. In these cases the crows amused themselves by pulling all the clothes-pins off the line just after the week's washing had been put out.

THOUSANDS OF BIRDS' STOMACHS MUST BE STUDIED

Two underlying factors make the crow, economically speaking, one of our most important birds. It is abundant and it is large. Birds, on the whole, require a volume of food in direct ratio to the size of their bodies, and no one has yet advanced the theory that crows are modest or restrained when dining. It follows, then, that what facts are determined regarding the character of the crow's food habits must be given more than ordinary consideration. Even a minor food habit of a bird so voracious and numerous as the one under discussion may have most important influences for good or harm.

How, then, it is asked, can one know to the point of exactness the food preferences of the crow? This is a most logical question. Ornithological literature is burdened with generalities regarding the food of birds—yes, and, I may add, inaccuracies—copied verbatim from some earlier writer, who in turn has simply served to pass the word along, so that today one can find many of Audubon's statements still doing overtime duty.

No element of disparagement of Audubon's work, which when published was the most exact of its kind, is implied by this statement; but modern necessity demands, and is rapidly securing, results far more accurate than the data secured by the field ornithologists of the early days.

The method employed involves extensive and intensive examination of the stomach contents of the birds under investigation. In this work the United States, through the agency of the U. S. Biological Survey, now leads the world.

No one, however, has ever looked upon economic ornithology, even in its most modern form, as one of the exact sciences. In dealing with birds we are dealing with living creatures — vivacious, whimsical, often erratic creatures—that sometimes seem never to do the same thing twice. But experience has shown that the benevolent law of averages, when applied even to a series of examined bird stomachs, produces results that are so close an approximation to the truth that the addition of large quantities of material fails to affect appreciably the result. Thus the greater the material, the more accurate the result.

In the case of the crow 2,118 stomachs, collected in 39 of our States, the District of Columbia, and some of the Canadian provinces, were available, and of these 778 were of nestling birds. This is the third largest quantity of stomach material ever used in the study of the food habits of a single species of bird.

THE CROW ENJOYS A VARIED MENU

The crow is primarily a terrestrial feeder and a most resourceful one. More than 625 specifically different items are at present known to furnish it sustenance. Herein lies the reason that it can survive the rigors of winter, and, when the halcyon days of early summer arrive, it knows also how to live and rear its young in true avian opulence. And the young, let me assure you, never languish for want of proper food, either in kind or quantity.

About 28 per cent of the animal food of the adult crow is secured from the animal kingdom and from fully a dozen different groups in that kingdom. In addition to such lowly organized creatures as earthworms, it secures nourishment also from crustaceans, all the common orders of insects, spiders, snails, and

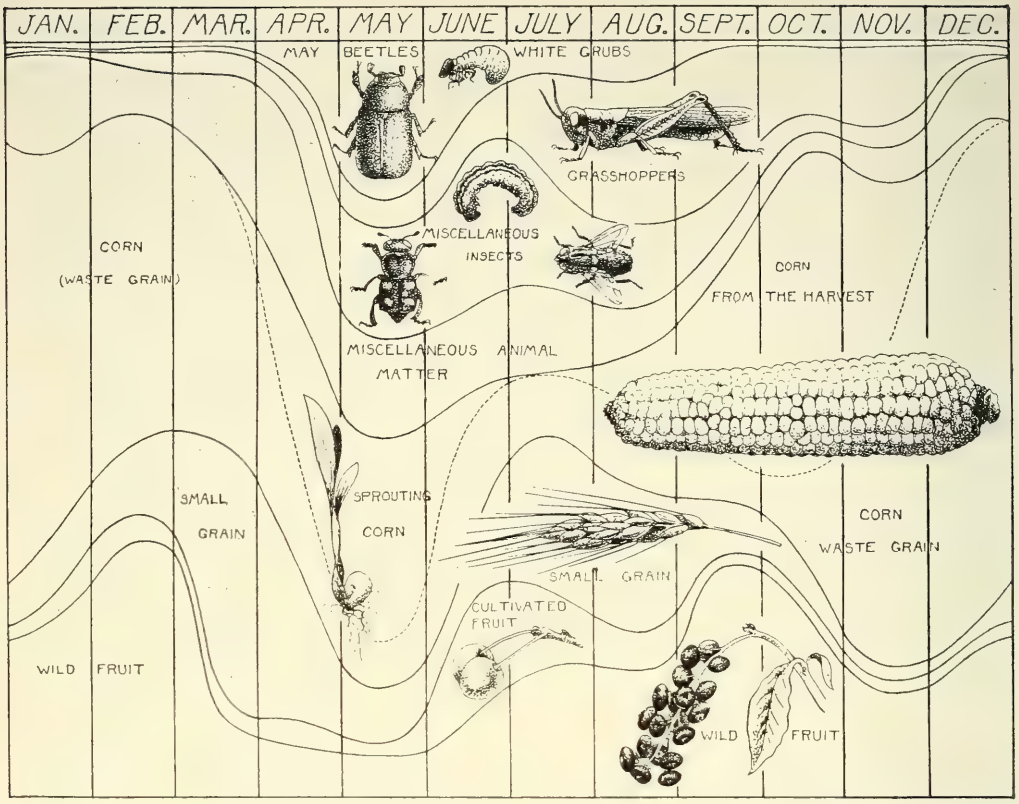


Chart from E. R. Kalmbach

A GRAPHIC PICTURE OF THE CROW'S FOOD, MONTH BY MONTH

The relative proportions of the principal food items are shown throughout the yearly cycle. The varying width of the bands representing the several items corresponds to the quantity of each food taken in successive months. The crow, like most birds, eats that which is most abundant and hence easiest to get. May beetles are taken mainly in May and June, grasshoppers from July to November, and other insect life is present throughout the warmer months. Corn constitutes the largest part of the crow's annual sustenance, but most of this is waste grain. The broken line dividing the corn sector separates that which is secured from the sprouting crop, in April, May, and June, and the ripening crop, in September, October, and November, from corn which is evidently waste.

numerous vertebrates, including fish, amphibians, reptiles, birds, and mammals.

It is in the consumption of certain of its animal food items that the crow renders man its greatest service, and in feeding on others has brought upon its head condemnation without end.

In its choice of insect food, which forms a little less than a fifth of the yearly sustenance, the crow leaves little to be desired. In this portion of the diet are found some of the worst pests with which the farmer has to contend—wireworms, cutworms, white grubs, and grasshoppers.

From the beginning of May until well into September, over a third of the crow's food is derived from insects alone, and were these creatures available the year around, the crow would be found doing yeoman duty throughout the seasons.

AN ENVIOUS RECORD IN THE DESTRUCTION OF INSECTS

As an effective enemy of May beetles, the parents of the destructive white grub, and of grasshoppers, no bird in the eastern United States is the equal of the crow in the point of numbers consumed. In May the beetles mentioned above constitute more than a fifth of the food of adult crows, while in August and September grasshoppers constitute nearly an equal

portion. Nestling crows also are fed large quantities of each of these insects.

A better idea of the avidity with which crows seek and devour such insect prey can be gained from the following presentation:

Of 197 adult crows collected in the month of May in many different States, 156 had fed to some extent on May beetles, and in several of the stomachs these pests formed more than 90 per cent of the contents.

A brood of three partly grown nestlings secured in Wisconsin had been fed on nothing else. Another brood of five from the District of Columbia had subsisted to the extent of nearly three-fourths of their food on these insects, an aggregate of about 70 individuals being consumed.

It remained, however, for 12 nestlings (three broods) raised in Kansas to carry off the honors as destroyers of May beetles. These 12 birds had at their last meal cared for 301 individuals, one taking as high as 53.

As grasshopper destroyers crows do even better. One wise old bird from southern Indiana had reduced the grasshopper population by 123, but among the young crows the laurel must again be bestowed upon the Kansas delegation. The most noteworthy work of grasshopper destruction by crows of which I have knowledge was performed by a half-grown brood of four secured at Onaga. These birds had consumed 133, 106, 105, and 74 respectively—a total of 418, or an average of about 104 apiece. Another nestling had eaten the surprisingly large number of 143!

It is noteworthy that these birds were all collected in years of normal grasshopper abundance, and what the crows would do during periods of grasshopper outbreak is an interesting subject for conjecture.

Aside from their war on May beetles and grasshoppers, the latter of which alone is charged with inflicting damage to the crops of American farmers totaling $50,000,000 annually, the crow renders invaluable service in other directions. The cotton-worm, the army-worm, the fall army-worm, the tussock moth, the spring canker-worm, the tent caterpillar, the gypsy and brown-tail moths, and the chinch-bug—what a rogues' gallery of the insect world!—all must attribute a part of their struggle for existence to the vigilance of the crow.

HOW MUCH DO CROWS EAT?

Some experiments have been made to determine the quantity of insect and other food required to sustain a crow. Mr. E. A. Samuels has stated that captive birds in his possession ate as much as eight ounces of animal food daily, while Forbush in working on young crows found "that when they were fed less than eight ounces per day they either did not increase in weight or fell off, and it was not until each crow was fed ten or more ounces that their weight increased." Dr. Ned Dearborn informs me that an adult crow in his possession ate an average of 4.83 ounces of animal food in a day.

Consider for a moment, then, the daily grasshopper consumption of a family of six crows, two old and four young, located, we will say, at Onaga, Kans., where in 1913 crows were found subsisting on grasshoppers to the extent of about 42 per cent of their food.

Allowing each of the young ten ounces of food a day and each of the adults five, it would take a daily ration of 50 ounces to supply their wants. Interpreting 42 per cent of this into terms of medium-sized grasshoppers, at the rate of about 87 per ounce, we find that such a corvine household under normal conditions would destroy over 1,827 of these pests every day the young were in the nest, and for the entire nestling period of about three weeks the surprising total of 38,367 hoppers would have been cared for!

AS A PREDACIOUS BIRD

Bird-lovers generally and sportsmen, game-keepers, and poultrymen in particular are vitally concerned with the crow's relation to other wild or domestic birds. There is no question that in part, at least, their apprehension, frequently expressed, is warranted. While the creation of game farms and preserves has served to bring this subject to the fore in recent years, the predatory habits of the crow are by no means recently acquired. The egg-stealing and bird-killing crow was present under primeval conditions,

and today is simply living true to its inherited instincts.

In the heronries along the out-of-the-way watercourses of Louisiana, under conditions wholly unaltered by the hand of man, I have seen these black marauders taking their toll; and again among the herons of the lower Santee, in South Carolina.

The anhingas and egrets of central Florida, the gulls and other waterfowl at Stump Lake, N. Dak., the sharp-tailed grouse of Manitoba, and the ducks of Saskatchewan are in these years fighting the same battles their ancestors fought centuries before. Are they fighting a losing battle, and does all of this mean that in the end the crow, not man, shall decree which of our birds posterity shall enjoy and which are to go?

Stomach examination in this case lends valuable but not complete information. The albumen of an egg or the soft body of a nestling bird soon disappears under the powerful digestive juices, and, even with the most careful work, items of this kind may be overlooked. The laboratory, however, has indicted the egg-stealing and bird-killing crow, but at the same time it conclusively refutes the exaggerated statements of extremists.

THE CROW IS NOT OFTEN A CANNIBAL

Wild birds and their eggs constitute only about one-third of 1 per cent of the annual food of the 1,340 adult crows examined. This resort to cannibalism occurred chiefly in the months of May, June, and July, the period in which the crow has to provide a copious animal diet for its young.

Under normal conditions about 1½ per cent of the food given to nestling crows also is secured at the expense of other birds. About 1 in every 28 adult crows and 1 in every 11 of the nestlings examined had partaken of the forbidden food.

Such incriminating evidence cannot be turned aside lightly. But there are mitigating circumstances that must be taken in consideration. In the first place, most of this destruction takes place during the nesting season of the crow, sufficiently early in the year to permit those species that have lost a first setting of eggs to lay and incubate a second clutch at a time when they will be little molested by the crow.

A goodly portion of the adult birds which the crow secures no doubt are cripples or weaklings, their elimination increasing the virility of the species preyed upon. And then, too, it must be borne in mind that crows habitually pass to each of their nestlings a portion of so dainty a meal as another bird's egg or young, with the result that, when stomachs are examined, a single act of vandalism may be recorded in each of four or five stomachs.

Distinction also should be made between the common crow and the fish-crow, which is notoriously a worse pilferer of nests.

In summing up the evidence that has come to hand, I am forced to the conclusion that in the vicinity of game farms and preserves, where it is the desire to foster certain species in an abundance greater than that decreed by Nature, the crow must be held in check.

Under natural conditions, game and insectivorous birds will hold their own, regardless of the crow, if furnished the necessary cover and not shot too close. Consequently, I doubt the wisdom of extensive crow campaigns, conducted with the sole object of improving game conditions over a large area.

Poultry furnishes about as much food for the crow as does wild-bird life; but most of this loss can be prevented by more careful housing. The shift-for-itself method of poultry-raising will always pay its toll to crows, hawks, and owls.

Chicken-stealing appears to be largely the trait of individual birds, which, by reason of the proximity of their nests or the accessibility of the poultry yard, have been afforded an easy means of getting a plentiful supply of nourishing food. The killing of one or two engaged in the practice will usually put a stop to such raids.

As a ravager of certain other forms of animal life, the crow exerts influences, some good and some bad. In feeding on mollusks and fish, nothing of great economic significance is involved. The frogs, salamanders, and toads it consumes are

From E. R. Kalmbach

WHAT IT TAKES TO RAISE A CROW

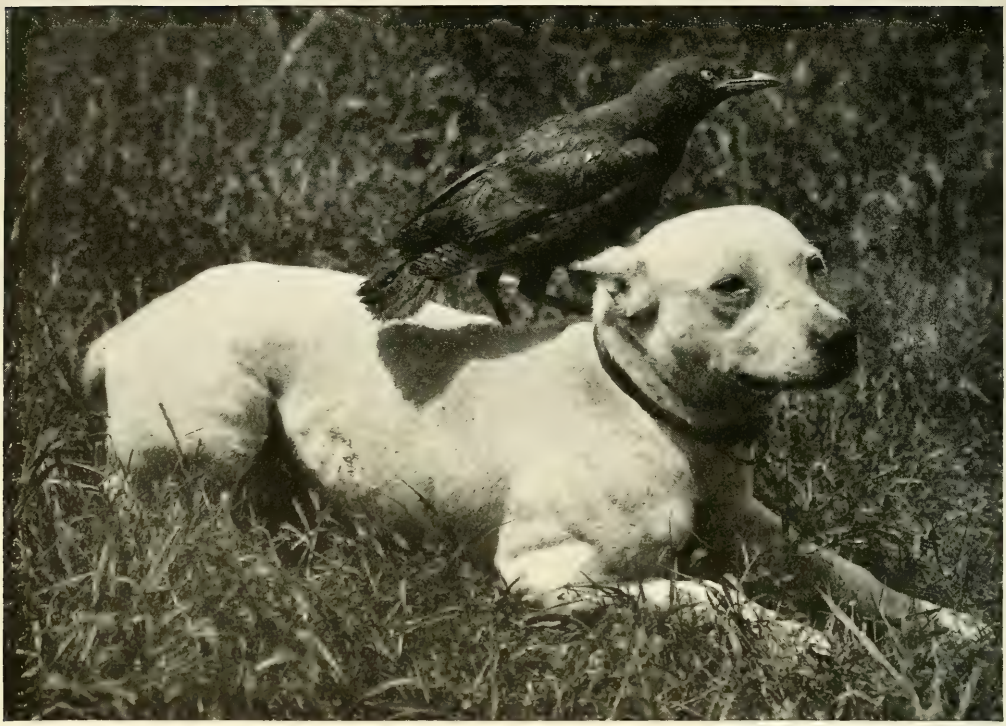
The nestling crow requires about 10 ounces of food per day, or about 13⅛ pounds for its nestling life of three weeks. At the end of that time it will weigh about a pound. During this period it will have eaten two and a quarter times its own weight of May beetles. The grasshoppers it has eaten would, if combined, form a mammoth insect about twice the size of the bird. Wild birds and poultry would each form a mass about a fifth of the crow's weight and corn about one and one-half times its mass. Here are pictured a fully fledged young crow and its principal food items. These include small mammals, spiders, caterpillars, May beetles, poultry, wild birds, miscellaneous beetles, carrion, corn, amphibians, crustaceans, and grasshoppers. These are all drawn to a scale that approximately represents the aggregate mass of the different items consumed during the nestling life, compared with the bird that ate them.

mainly insectivorous, and their loss is to be deplored, but in the destruction of mice of various kinds the crow serves the best interests of the farmer.

THE CROW IN THE CORN-FIELD

The crow and the corn crop are inseparable. Corn is the crow's staff of life, though much of what it takes is eaten more from dire necessity than from choice. Corn forms over 38 per cent of the adult crow's food; but by far the largest portion is consumed from the middle of November to the end of March, a time when there is no sprouting grain to be had and when the crop of the year should be securely housed. It appears, then, that waste grain forms the greater portion of the crow's corn diet.

This fact, however, does not absolve the



Photograph by Dr. J. B. Pardoe

BLACK AND WHITE, A STUDY IN CONTRASTS

A dog and a crow would seem to be strange playmates, but a student of bird life tells of two such comrades who were raised on a farm. The chief sport of the crow consisted in laying a stick within easy reach of the dog while the latter slept, then waking him with a nip on the heels. Whereupon, the bird would seize the stick and fly across the field with the dog in hot pursuit. The chase would continue until both play-fellows were exhausted (see text, page 329).

crow from all blame in connection with the damage inflicted on sprouting corn or on the harvest before it has been removed from the fields. It is one case where stomach examination is hardly necessary; but stomach examination has been made and it has convicted the bird. The court of last appeal has returned an adverse verdict, with, however, a recommendation for clemency.

In the Middle West, where fields of corn reach to the horizon and beyond, the crow is an unimportant factor, though it is present in considerable numbers. The birds, no doubt, take their toll, but the crop is so great that their depredations are insignificant.

In smaller fields—for instance, in the hilly sections of northern New Jersey—damage is often severe. But even here one can resort to measures that in the main will frustrate the crow's intentions. That same shrewdness that stands the crow in such good stead in its struggle for existence may be used by man to accomplish his own ends. No bird detects danger and remembers unfortunate adventures more readily than the crow. Even the use of coal-tar, with its gassy smell, applied to seed grain has brought relief from the corn-pulling crow, and the killing of a few birds, either by shooting or by the use of poisoned grain, will usually secure immunity for small fields.

THE CROW LEARNS HIS LESSON IN WASHINGTON STATE

While poison should be used sparingly and judiciously, so as not seriously to endanger other wild life, there is no question of its efficacy against crows.

This fact was never more forcefully

demonstrated than during the past season, when the crows of Klickitat County, Washington, were attempting to repeat their annual feast in the groves of green almonds at Goodnoe Hills. For several years these birds, roosting in thousands in the hilly country bordering the Columbia River, had been growing increasingly bold in their sorties.

The loss to some growers was 100 per cent, for when a flock of 10,000 or more crows settled in a grove of fifteen acres a few hours' feast would strip the trees.

Scare-crows had availed nothing and shooting brought only temporary relief. Even sporadic efforts at poisoning, in which carcasses and grain had been used as bait, failed to serve the purpose. A few crows were killed, with the result that the rest studiously avoided the carcasses and the grain, but kept on eating the nuts.

It was not until some one conceived the idea of feeding the marauders poisoned almonds that relief was gained. Only a few crows were killed by this method, but their comrades had witnessed their fall. Abject despair seemed to seize the mighty host. The flock rose from the grove as a monstrous black cloud, and, with a deafening roar of protesting voices that could be heard for miles, it left Goodnoe Hills. Some almond groves of the Hills were severely damaged, even this year, but in those where a few poisoned almonds had been placed crow damage had been reduced from a possible 100 to about 2 per cent.

A WAR OF CROW EXTERMINATION NOT WARRANTED

Our enormous corn crop has greatly simplified the crow's winter task of making a living, as the other vegetable food items of the crow constitute by no means a highly nutritious assortment.

The hardened fruits of dogwood, sourgum, greenbrier, smilax, Virginia creeper, sumac, poke-weed, a few acorns, and the wax-covered seeds of bayberry, poison ivy, and poison oak constituted the chief sources of food for the North American crows in pre-Columbian times. Today they still get a portion of their sustenance from these sources, and at their winter roosts may be found heavy deposits of the indigestible portions of these fruits.

When all is said and done, one is forced to the conclusion that legislation which permits the killing of crows whenever they are doing damage is necessary. Such permission is now granted under the laws of all States in which crows are numerous.

On the other hand, bounty laws that result in the killing of crows in places and at times when they may be doing great good are reactionary. Only in rare cases is it conceivable that drastic control measures for the protection of crops are warranted for areas as large as an average State. Misguided efforts that at times gain impetus for nation-wide crow campaigns on the pretext that a near or complete extermination of the bird would benefit the American farmer cannot be justified if all the evidence is fairly presented.

THE HUMAN ATTRIBUTES OF THE ROBIN HOODS OF THE BIRD WORLD

Aside from any economic considerations which are sufficient in themselves, the passing of the crow would leave a distinct void in our attractive bird life. Its crimes are many, but its virtues must not be overlooked (see also page 334).

Who can deny that our Robin Hoods and other adventurous spirits have left us in the story of their lives, though checkered, much that is good and much to be admired? The world would have been poorer without them. To one whose association with the crow has been at all intimate, there comes a bit of the same feeling.

There is much of human character—fear and boldness, affection and hate, ingenuity, perseverence, and revenge—to be found in the life habits of this interesting bird. Let those who would actually exterminate it pause long enough in their efforts to learn more of the crow's real and potential powers in the control of certain pests. Then, and only then, will the general attitude toward the bird become an intelligent one.

THE NATIONAL GEOGRAPHIC SOCIETY'S NOTABLE YEAR

NOTABLE advance in usefulness and growth in membership have marked the history of the National Geographic Society during the past year. Its accomplishments in the increase and diffusion of geographic knowledge are the occasion for cordial congratulation of the more than 750,000 individual members; it is their faith and their support of the organization's aims that have heartened and encouraged those to whom has been entrusted the direction of The Society's activities.

In recognition of The Society's service to geography, and particularly in appreciation of its grant of funds which saved some of the Big Trees of the Sequoia National Park, California, from destruction at the hands of commercial interests, James C. Horgan, of Los Angeles, made a bequest during the year of $8,000, the income from which is to be used for The Society's work.

THE SOCIETY ADDS TO THE WORLD'S KNOWLEDGE OF VOLCANIC ACTION

Foremost among the achievements of The Society during the past few months was the splendid success of the sixth expedition dispatched to the region of Mount Katmai, the world's largest active volcano. There an exhaustive study was made of the now famous "Valley of Ten Thousand Smokes," discovered by an earlier Geographic expedition and recognized today as perhaps the most remarkable natural phenomenon on the face of the globe—an area where chemists, physicists, geologists, and petrographers may actually study the processes by which the earth has evolved through the ages from a seething mass of matter into a habitable planet.

A SPLENDID HARBOR DISCOVERED

The 1919 expedition, which sailed from Seattle eleven months ago and which completed its work late in the autumn, was equipped at a cost of more than $30,000, but the treasure of knowledge which it brought back to The Society's members and which is to be given to the scientific world represents inestimable dividends in the form of facts.

One of the most significant accomplishments of this expedition was the discovery of a magnificent harbor, christened Geographic Harbor in honor of The Society, near the entrance to the valley. This find will result inevitably in the opening of this region to tourist travel, and it requires no prophetic vision to see Mount Katmai and its surrounding wonderland, already a national monument by presidential proclamation, elevated in the near future to the importance of a national park, in which all America may enjoy the marvels of its awesome majesty, the beauty of its fairy flowerland in summer, the charm of its woodlands, and the fascination of its wild life.

The findings of the sixth expedition were recorded by both motion picture and color photography. The films of the former have been shown to the members in the National Capital, and it is hoped that arrangements can be made to exhibit them to Geographic members throughout the United States. The official report of the leader of the expedition, Prof. R. F. Griggs, will, as in the case of all previous expeditions organized by The Society, be told, with a wealth of illustrations, in an early number of the NATIONAL GEOGRAPHIC MAGAZINE.

HUBBARD MEDAL AWARDED TO STEFANSSON

Supplementing its own achievements in the world of exploration, the National Geographic Society saw fit to pay tribute to the services of a distinguished explorer who has added more than 100,000 square miles to the mapped area of the Western Hemisphere. This explorer, Vilhjalmur Stefansson, was awarded the Hubbard Gold Medal of The Society, and upon that occasion the recipient of the honor was introduced to the members present by two of the foremost figures in the history of Polar exploration—Rear Admiral Robert E. Peary, discoverer of the North Pole, and Major-General A. W. Greely, leader of the Greely International Polar Expedition of 1881-'84, and for 14 years holder of the record for the Farthest North.

ADMIRAL PEARY'S LAST PUBLIC APPEARANCE

It was at this meeting of The Society that Admiral Peary made his last public appearance to pay the following tribute to his fellow-explorer:

"Fellow-members of the National Geographic Society:

"Today we add another to the long list of Polar explorers, both north and south, whom our Society has welcomed and to whom our members have listened with absorbing interest.

"Six years ago, in the parlor of a hotel in Rome, I said good-bye to another confident young friend of mine who was starting then for home in order to begin one of our latest Polar quests. I met him here today for the first time since then. How much has happened to him in those six years I need not attempt to relate. Five and one-half years of those six this man has been there in the Arctic regions adding to the sum of the world's knowledge. Five and one-half years!

A NEW TYPE OF EXPLORER COMING

"It is not my intent to go into a résumé of his work. He is going to tell you that himself, but I can note very briefly that within that time Stefansson has added more than 100,000 square miles to the maps of that region—the greatest single addition made for years in Arctic regions. He has outlined three islands that were entirely unknown before, and his observations in other directions, the elimination of the continental shelf, filling in of unknown gaps in the Arctic archipelago, and his help in summing up our knowledge of those regions are in fact invaluable.

"Stefansson is perhaps the last of the old school, the old régime of Arctic and Antarctic explorers, the worker with the dog and the sledge, among whom he easily holds a place in the first rank. Coming Polar explorers, both north and south, are quite likely to use modern means which have sprung into existence within the last few years.

"According to my own personal impressions—aërial flights; according to Stefansson, he would like to try his chances with a submarine; but whether it be aëroplane or submarine, it will mean the end of the old-time method with the dog and the sledge and man trudging alongside or behind them.

"What Stefansson stands for is this: he has grasped the meaning of Polar work and has pursued his task in the Arctic regions section by section. He has profited by experience piled upon experience until he knows how to face and overcome every problem of the North. His method of work is to take the white man's brains and intelligence and the white man's persistence and will-power into the Arctic, and supplement these forces with the wood-craft, or, I should say, polar-craft, of the Eskimo—the ability to live off the land itself, the ability to use every one of the few possibilities of those frozen regions—and concentrate on his work.

"Stefansson has evolved a way to make himself absolutely self-sustaining. He could have lived in the Arctic fifteen and a half years just as easily as five and a half years. By combining great natural, physical, and mental ability with hard, practical, common sense, he has made an absolute record.

"Stefansson has not only fought and overcome those ever-present contingencies of the Arctic region—cold and hunger, wet and starvation, and all that goes with them—but he has fought and overcome sickness—first, typhoid; then pneumonia, and then pleurisy—up in those forbidding regions, and then has been obliged to go by sled four hundred miles before finding the shelter of a hospital and the care of a physician."

GENERAL GREELY'S TRIBUTE TO STEFANSSON

Major General Greely likewise paid a memorable tribute to the Hubbard Gold Medalist:

"At this meeting of the members of the National Geographic Society to do honor to an American explorer, there rises in my mind a throng of memories of that three years of Arctic service, so far buried in the past, when it was action, action, always action, and not, as now, the uttering of a word.

"The Bible tells us that Isaiah saw a

word—that is, a vision over the Holy Land centering in known Jerusalem. We, too, had visions which were over the vast expanse of the white north, unseen by human eye since the dawn of creation. Though barren, desolate, unknown, and strangely mysterious, it has been a goal for the adventurous of all nations.

"Among such seekers we are honored tonight by the presence of two officers of the Russian navy, Lieutenants Nikolsky and Evgenoff. With Captain Vilkitsky, they were the first to navigate from east to west the Siberian ocean, from Bering Strait to the North Sea. They also gave to the world a new Arctic archipelago, Nicholas II Land, north of Cape Chelyuskin, the promontory that projects farthest into that ice-encumbered sea. They were brought near in sympathy and helpfulness to the speaker of the evening, for they tried, though in vain, defeated by the pack, to rescue the survivors of the *Karluk*, then marooned on Wrangell Land.

"We come together especially to welcome back Vilhjalmur Stefansson, whose published obituary you have read, but who insists with Mark Twain that the account of his death has been greatly exaggerated. However, it told indirectly the tale of his dangers and hardships.

"THE WORLD'S RECORD FOR CONTINUOUS POLAR SERVICE"

"Stefansson has several unique Arctic records. His five and a half years is the world's record for continuous Polar service. A pioneer in living on the game of the region, whether on the ice-covered sea or on the northern lands, he also initiated distant journeys on the ice-floes of an unknown sea, which carried him hundreds of miles from the nearest land.

"The contributions of his expeditions are important and extensive. Besides the natural history and geologic knowledge, he has made inroads into the million square miles of unknown Arctic regions, the largest for many years. His hydrographic work is specially important, in surveys and in magnetic declinations. His numerous soundings not only outline the continental shelf from Alaska to Prince Patrick Island, but also disclose the submarine mountains and valleys of the bed of Beaufort Sea.

"From the unknown regions of Arctic land and sea he has withdrawn areas amounting to approximately 100,000 square miles. These discoveries comprise about 65,000 square miles of Beaufort Sea to the north of the Mackenzie basin, 10,000 square miles of the Arctic Ocean west of Prince Patrick Island, over 3,000 square miles along the northeast coast of Victoria Island, and over 15,000 square miles of land and sea to the northeast of Prince Patrick Island. In the last-named region three large and other small islands were discovered between latitude 73 degrees and 80.2 degrees north and between longitude 98 degrees west and 115 degrees west.

"These new islands unquestionably fill in the last gap in the hitherto-unknown seaward limits of the great Arctic archipelago to the north of the continent of America.

"The spirit as well as the material results of exploration should be recognized. Tonight the borderland of the White Sea is in the thoughts and hearts of many, for there, in the gloom of Arctic twilight, and in the cold of a Polar winter, the heroic men of this great nation are enduring fearful hardships and periling their young lives to restore peace and give freedom to unfortunate Russia.

"Recall that in the dawn of that nation's history, through this sea and the port of Archangel only could Russia be reached. More than three and a half centuries ago, the first great maritime expedition of England sailed to the White Sea, and Chancellor's visit had potent results in the development of both England and Russia.

"Of this great voyage Milton said: 'It was an enterprise almost heroic were it not for gain.' Stefansson's explorations are untainted by motives of materialism.

"WE WHO ARE ABOUT TO DIE SALUTE HIM"

"In recognition both of the idealistic spirit and of the geographic importance of the discoveries made by Vilhjalmur Stefansson, the Board of Managers of the National Geographic Society unanimously direct me to present to him the Hubbard Medal.

"It is to be added that the three survivors of the so-called Greely Interna-

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REAR ADMIRAL JOHN ELLIOTT PILLSBURY, U. S. N., LATE PRESIDENT OF THE NATIONAL GEOGRAPHIC SOCIETY

The distinguished naval officer and authority on the Gulf Stream, who died December 30, 1919, had been a member of the National Geographic Society's Board of Managers for more than ten years, and had served as its Vice-President from 1915 until his election to the Presidency of the organization, April 16, 1919.

tional Polar Expedition are too far advanced in years again to hazard Polar work; but as explorers of the 19th century who first wrested from England a record held for three hundred years—that of the farthest north—they wish to honor the explorer of the 20th century who surpasses them.

"Appreciative of Stefansson's endurance of hardships, recognizing his ability in devising new methods, his courage in testing such methods, and his standing as a typical Arctic explorer, the members of the Greely Expedition, who are about to die, salute him." *

EIGHT GEOGRAPHERS AWARDED JANE M. SMITH LIFE MEMBERSHIPS

The Society also recognized the achievements of eight other distinguished geographers by electing them to life membership under the terms governing the endowment fund of $5,000 bequeathed by the late Miss Jane M. Smith, of Pittsburgh. The men thus honored were:

Rear Admiral Joseph Strauss, U. S. N.; E. W. Nelson, Frank G. Carpenter, Prof. Robert F. Griggs, Walter T. Swingle, O. F. Cook, William H. Holmes, and Stephen T. Mather.†

Reasons underlying the choice of these men of science reveal a fascinating story of geographic achievement.

Checking Germany's U-boat warfare by the North Sea mine barrage is universally accounted to have been a major factor in the Allied victory. Preliminary to this gigantic task a needful element to the success of the operation was a study of the geography of the North Sea region—a study made by Rear Admiral Joseph Strauss, who was in command of the expeditions that laid and removed the mines.‡

Beside this recent mark of distinction, Admiral Strauss already was known for his invention of the superposed turret system of mounting guns on battleships, for his part in the blockade of the Cuban coast, for his experimental work in torpedoes, and for his writings on ordnance and ballistics.

Walter T. Swingle's name is associated with the American raising of Smyrna figs; for until he introduced the insect necessary for fertilization of this variety, at Fresno, California, in 1899, the imported fig trees grew, but bore no fruit. Mr. Swingle has also devised numerous improvements to microscopes, made agricultural explorations in many lands, originated "citranges" by hybridization, in Florida, and introduced the date palm, pistachio nut, and other plants of Mediterranean origin into the United States.

Known to every student of animal life is the work of Edward W. Nelson, Chief of the U. S. Biological Survey, who has contributed notably to the information concerning animal life of North America, from the time when he conducted pioneer scientific explorations in Alaska, forty years ago, to his more recent expeditions to examine the zoölogy and botany of Mexico. Results of a major line of his investigations have been published by the NATIONAL GEOGRAPHIC MAGAZINE and later by the Society in a volume entitled "Wild Animals of North America."

A GREAT TEACHER

No less important than the increase of geographic knowledge, the National Geographic Society has always held, is its diffusion, and on this basis, especially, recognition was accorded Frank G. Carpenter. First as a newspaper correspondent, later as a travel writer, and also as an author of some admirable school geographies, Mr. Carpenter has stimulated interest in geographic knowledge and made intelligible to the general public a vast amount of informative data.

O. F. Cook was honored for his studies of Machu Picchu, the lost city of the Incas, which was found by Colonel Hiram Bingham, leader of the National Geo-

*A most interesting article, "The Development of Northern Canada," by Mr. Stefansson, will appear in an early number of THE GEOGRAPHIC.

† Only five other life memberships have been awarded previously under the provisions of Miss Smith's bequest, those being to Colonel Hiram Bingham, Colonel Alfred H. Brooks, Dr. William H. Dall, George Kennan, explorer and first Secretary of the National Geographic Society, and Henry Pittier.

‡ See NATIONAL GEOGRAPHIC MAGAZINE, February, 1920, and February, 1919.

graphic Society's Peruvian expeditions. In the vicinity of Machu Picchu were discovered many remarkable ruins of a pre-Columbian civilization, including the wonderful hanging gardens, where it is thought that great food resource, the potato, originated.*

Prof. Robert F. Griggs was honored for service rendered to science while at the head of National Geographic Society expeditions to Mount Katmai (see page 338).

William Henry Holmes, now Head Curator of Anthropology, National Museum, has left his impress both in science and art. In the former field his original work in ethnology, archeology, and geology have valuable geographic significance.

In recognition of his substantial service in the upbuilding of the national park system, of the marked impetus he has given to interest in America's natural beauties and wonders, and his success in making these national play places accessible, Stephen T. Mather, Director of the National Park Service, was elected a Jane M. Smith life member.

THE GEOGRAPHIC MAGAZINE GOES TO 750,000 HOMES

Month by month The Society's official organ, the NATIONAL GEOGRAPHIC MAGAZINE, with a steadily increasing number of readers, has been instrumental in diffusing geographic information in 750,000 homes by removing the padlock of technicality from the most inclusive of all sciences—that which "treats of the earth and its life, the description of land, sea, and air, the distribution of plant and animal life, including man and his industries, with reference to the mutual relations of these diverse elements."

The Society has a warehouse full of map paper, representing an investment of $50,000, and as soon as the various commissions have defined the new frontiers of Europe, Asia, and Africa, it is the intention of the Magazine to print a complete set of maps.

Two recent numbers have been especially noteworthy contributions to knowledge—the Dog Number, with color portraits of 73 species of man's historic and best-loved animal friend, and the Military Insignia Number, of special value and interest to the 4,000,000 Americans who were in the uniformed service of their country during the World War, and to their relatives and friends. The latter number, superbly illustrated in colors, gave an epitomized history of the medals, decorations, ribbons, and organization shoulder insignia authorized by the United States Government, and proved an especially valuable sequel to The Society's famous Flag Number of October, 1917.

GEOGRAPHIC BULLETINS REACH TWELVE MILLION READERS

Through the columns of more than 550 of the leading American newspapers, The Society's daily Geographic News Bulletins are reaching twelve million readers. By means of these bulletins, which are furnished to the daily press without charge, The Society is enabled to interpret the historic and geographic backgrounds which give significance to news dispatches from every corner of the globe.

So important have these bulletins proved as an educational force, that through the co-operation of the United States Department of the Interior, Bureau of Education, the urgent appeals of more than 60,000 school teachers have been met and this geographic information, in attractive illustrated form, is now being issued weekly for class-room use. Thus educators in every State of the Union are receiving the assistance of The Society in vivifying and vitalizing for their pupils the mere names of places into communities where human beings live and move and have their being.

A further educational activity inaugurated by The Society in recent months is its PICTORIAL GEOGRAPHY. By means of this series of loose-leaf geographic text and pictures, the bewildering "dots and dashes" of the average map and the technical phraseology of physical geography are deciphered into mental pictures of busy places, living peoples, beautiful landscapes, Nature's moods and processes, for America's millions of school children.

* See "Staircase Farms of the Ancients" by O. F. Cook, NATIONAL GEOGRAPHIC MAGAZINE, May, 1916.

Photograph by C. S. Reeves

CROSSING PACKWOOD GLACIER, GOAT MOUNTAINS, WASHINGTON, WITH TWENTY-FOUR HUNDRED SHEEP, AT AN ALTITUDE OF 7,500 FEET

DEATH REMOVES THREE DISTINGUISHED LEADERS

Unhappily, The Society's most successful year has been saddened by the death of three of its leaders—Brigadier-General John M. Wilson, Rear Admiral John E. Pillsbury, and Rear Admiral Robert E. Peary.

General Wilson, who had been a member of The Society's Board of Managers for fourteen years, had a distinguished military career. He was at one time Superintendent of the United States Military Academy at West Point, was Chief of Engineers of the Army during the Spanish-American War, and, to quote from the resolutions passed by his colleagues on The Society's Board, following his death, "It is a noteworthy coincidence that the Washington Monument, ideal symbol of the character of the first President of the Republic, was completed under the direction of General Wilson, thus serving as a memorial to an officer and public servant of similar integrity of character and unselfish service to his fellow-men."

THE LATE PRESIDENT ADMIRAL PILLSBURY

In the death of Admiral Pillsbury, on December 30, 1919, The Society lost its President and a distinguished contributor to its magazine. As a naval officer he served with distinction during the Spanish-American War, being in command of the dynamite cruiser *Vesuvius* at the siege of Santiago, but it is on account of his notable work in studying the Gulf Stream that Admiral Pillsbury's name is written largest in the history of his country.

As commander of the Coast Survey steamer *Blake*, he employed a device of his own invention to anchor that vessel in depths of more than two miles, and studied currents there by means of contrivances also of his own making. Thus, after seven years of study, he established the position of the axis of the Gulf Stream and determined many of the laws by which its flow is governed.

A digest of his work in this important field of oceanography was written for the NATIONAL GEOGRAPHIC MAGAZINE and published in August, 1912. Admiral Pillsbury became a member of The Society's Board of Managers in 1909, was elected Vice-President in 1915, and became President April 16, 1919.

An outline of the career of Rear Admiral Peary, the third member of the Board of Managers to be removed by death within recent months (February 19, 1920), is given in the preceding pages of this number of THE GEOGRAPHIC.

THE NEW PRESIDENT

Upon the death of Admiral Pillsbury, the Board of Managers of The Society elected as his successor to the Presidency Gilbert Grosvenor, for twenty-one years the Editor of THE GEOGRAPHIC MAGAZINE and the Director of The Society. Under Mr. Grosvenor's direction, the membership of The Society has increased from 900, in 1899, to more than 750,000. Mr. Grosvenor continues as the Editor.

John Oliver La Gorce, Vice-Director of The Society and Associate Editor of the magazine, was elected to succeed to the place on the Board of Managers left vacant by Admiral Pillsbury's death.

In the history of civilization, there is no other instance of a vast coöperative educational and scientific association organized and developed like the National Geographic Society and commanding such widespread public support.

It is not a commercial enterprise but an altruistic institution, and the only dividend which it pays is the geographic knowledge it disburses primarily to all its members and secondarily to the world at large.

In The Society's constructive service to humanity in a wounded and distrustful world, its members have cause for pride and personal satisfaction. As their agency, The Society is one of the most effective forces in bringing about a better understanding among the nations of the world. To millions of Americans, The Society's pictures and descriptive articles have made foreign races and their lands human realities rather than mere dots on maps or political boundary lines.

The Society has grown because it ministers to the basic desire of intelligent citizens to understand other peoples and to know better the earth whence they derive their livelihood.

THE SALVATION ARMY IN INDIA

The British Government has entrusted to the Salvation Army the management of its numerous criminal tribes of the hill country and the problems of the poor.

AROUND THE WORLD WITH THE SALVATION ARMY

By Evangeline Booth

Commander Salvation Army

FOR more than half a century the historic banner of the Salvation Army has been raised over the battered towers and broken gates of despairing, wounded humanity, but half of the world never knew about it. It took the blood and agony of a great war to demonstrate the fire of a faith which has planted its standards in every country on the earth.

"Around the world with the Salvation Army" is not a challenge or a prophecy; it is an accomplished fact.

The Army is working in sixty-three countries and colonies, preaching the gospel in forty languages. Our periodicals, printed in thirty-nine different languages, reach a circulation of 1,184,000 a week. More than 23,000 officers and cadets plan and execute our strategy against insidious foes—poverty, sin, sickness, and despair. It was for that we were called an army.

Wherever there is an earthquake, a fire, a world war, or any great human need, there you will find the Salvation Army. It seems quite natural to report that more than 105,000 Salvationists fought in the different armies on the Allied fronts.

So, step by step, the Army is marching on. It has crossed lances with Buddha and Confucius. Offering ministration to the forgotten ones in desolate places, Salvation Army lassies and men have gone into leper colonies and planted the Cross on pagan soil.

INTENSIVE TRAINING FOR SALVATION ARMY OFFICERS

Few have even a remote idea of the extensive training given to all Salvation Army officers by our military system of education, that covers all the tactics of the particular warfare to which they have consecrated their lives—*the service of humanity*. We have in the Salvation Army thirty-nine training schools in which our men and women, both for our missionary and home fields, receive intelligent tuition and practical training in the minutest details of their service.

They are trained in the finest and most intricate of all the arts, the art of dealing ably with human life.

It is a wonderful art which transfigures a sheet of cold, gray canvas into a throbbing vitality, and on its inanimate spread visualizes a living picture.

It is a wonderful art which takes a rugged block of marble, standing upon a wooden bench, and cuts out of its uncomely crudeness—as I saw it done—the face of my father, with its every feature illumined with prophetic light, so true to life that I felt that to my touch it surely must respond.

But even such arts as these crumble: they are as dust under our feet compared with that much greater art, *the art of dealing ably with human* life in all its varying conditions and phases.

It is in this art that we seek by a most careful culture and training to perfect our officers.

They are trained in those expert measures which enable them to handle satisfactorily those who cannot handle themselves; those who have lost their grip on things, and who, if unaided, go down under the high, rough tides.

Trained to meet emergencies of every character; to leap into the breach; to span the gulf; to do it without waiting to be told how.

Trained to press at every cost for the desired end.

Trained to obey orders willingly and gladly and wholly, *not in part*.

Trained to give no quarter to the enemy, no matter what the character, nor in what form he may present himself.

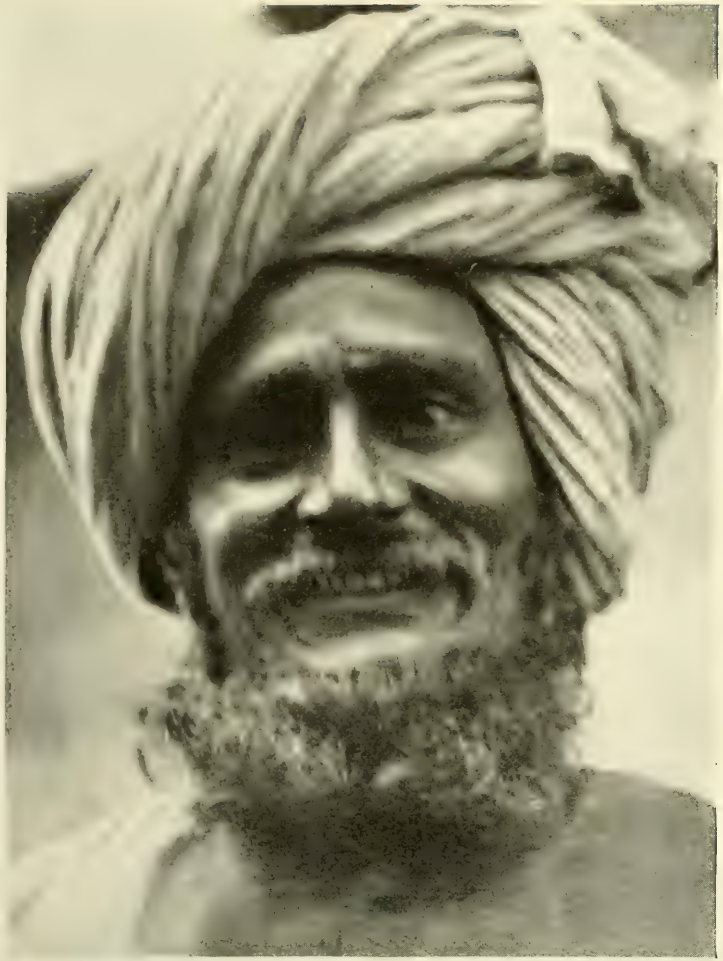
Trained in the art of the winsome, attractive coquetries of the round, brown doughnut! And all her kindred.

THE HINDU VERSION OF THE BASS DRUM, TAMBOURINE, AND TRUMPET

The Salvation Army Empire is a tangle of races, tongues, and colors, of types of civilization and enlightened barbarism such as never before were gathered under one flag.

ON INDIA'S CORAL STRAND: A SALVATION ARMY HOME FOR GIRLS IN FAR-OFF HINDU LAND

Seventy-one nationalities are now marshaled under the Salvation Army's Banner of Blood and Fire, working to destroy idols of wood and stone, and to convert temples into such homes as this.



ONCE AN OUTLAW, NOW A SOLDIER IN HUMAN SERVICE

This chieftain of an East Indian criminal tribe has become a Salvation Army worker in charge of one of the Army's farm colonies.

THE SALVATION ARMY LASSIE OF JAVA

The curious inscription on the uniform of this swarthy-complexioned Far East worker means "Salvation Army."

Trained, if needs-be, to seal their services with their life blood.

One of our women officers on being told by the colonel of a regiment that she would be killed if she persisted in serving her doughnuts and cocoa to the men while under heavy fire, and that she must get back to safety, replied: "Colonel, we can die with the men, but we cannot leave them."

SEVENTY-ONE NATIONALITIES UNDER ONE BANNER

By imperial decree the Emperor of Japan recently granted an annual fund for the work of the Salvation Army in his kingdom. India has turned over to the Army the management of its great criminal tribes and the problems of its poor.

As the work has grown, it has been increasingly apparent that the faith which regenerates men recognizes no barrier of nationality or geographical limitation. Seventy-one nationalities are now marshaled under the banner of blood and fire, working to destroy old idols of wood and stone and turning the temples of the gods, after due cleansing, into Christian meeting-places.

The work in India will be forever linked with the name of its pioneer commissioner, F. de Latour Booth Tucker. Judge Tucker was greatly interested in the Salvation Army while in the service of the British Crown in India in the early days of the movement. There came a time when he gladly resigned his government position, with all that it meant to him personally in the way of official success, and came into the Army to wear the flowing robes of the natives and to extend the work in the very heart of the continent.

Salvation Army settlements for criminal tribes are unique in the annals of social work throughout the world. Out in the hill country there are entire tribes of criminals for which the prevailing caste system is largely responsible. They marry and intermarry, and their children, born outcasts, are doomed to go through life branded as criminals.

For years these Ishmaelites have been a source of constant worry to the British Government. Finally, in an effort to reach a practical solution and meet the growing need, the government turned over the management of these tribes to the Salvation Army.

Sir John Hewett came to terms with General Booth. The British Government agreed to provide the territory and the Salvation Army undertook to provide the men. The criminal tribes were to be brought into a certain territory and the Salvationists were to be responsible for their regeneration.

It was Harold Begbie who first reported the historic meeting of Sir John Hewett, then Lieutenant-Governor of the United (Indian) Provinces, with my father, the late General and founder of our organization.

Sir John had heard of the Army's work in salvaging men, and it struck him at once that similar methods might be successful with the wandering tribes which roamed the hills, a menace to the people and a vexing political problem. He visited General Booth and together these two, so unlike in many ways, discussed methods of reclaiming men, of making them over into useful citizens.

"YOU CANNOT MAKE A MAN CLEAN BY WASHING HIS SHIRT"

The old patriarch brought to the mind of the statesman one of the great fundamental truths of human experience, too often neglected by legislators and sometimes conveniently ignored by the enemies of religion:

"You cannot make a man clean by washing his shirt," General Booth exclaimed. "If you have a bad man to deal with, you must first seek to alter the set and current of his soul. I will tell you the secret of governing tribes and nations of evil-doers. It is religion.

"Give them religion. If you alter the circumstances of a man's life, and set him in conditions where his liability to vice is small, and where he knows his sins will be most surely punished, you will not go far, if that is all you have to give him.

"You cannot deal with the body of a man when it is his soul that is the cause of all the trouble; that is to encounter

HINDU RECRUITS OF THE SALVATION ARMY IN INDIA

Note the Mohammedan woman, who, despite her adoption of the Christian faith, adheres to the practice of her people in shielding her face from the eye of the camera.

A HOME-MADE SALVATION ARMY BAND IN INDIA

The Salvation Army workers in the Far East are no respecters of the man-created caste system which has blighted oriental life for centuries.

ZULU WARDS OF THE SOUTH AFRICAN BRANCH OF THE SALVATION ARMY

"We look through the exterior, look through the shell, look through the coat, and find the man."

A SALVATION ARMY HOME FOR NATIVE BOYS IN JAVA

This organization now has 21,000 commanding officers who voice their doctrine of deeds in forty tongues.

WITH THE SALVATION ARMY IN JAVA

The man at the reader's right is wearing the regulation Salvation Army uniform of the Javanese branch of this world-wide organization.

inevitable failure. Only one power is known in all the long experience of human history by which a bad man can become a good man, and that power is religion."

Years passed and the work of the Salvation Army strengthened and grew. There was just one way to success, and that was to remake men into some semblance of law-abiding, useful citizens. It was the human equation which counted and by this test must the work of the Salvation Army be gauged in India, as elsewhere.

"Boom marches" constitute a phase of the work conducted in India. Groups of four or five Salvationists in native dress tramp the roads that lead into the interior. From the roadside in heathen villages and towns they proclaim with simplicity and force the unsearchable riches of Christianity. In careful detail they explain what it all means to the head man of the village tribe.

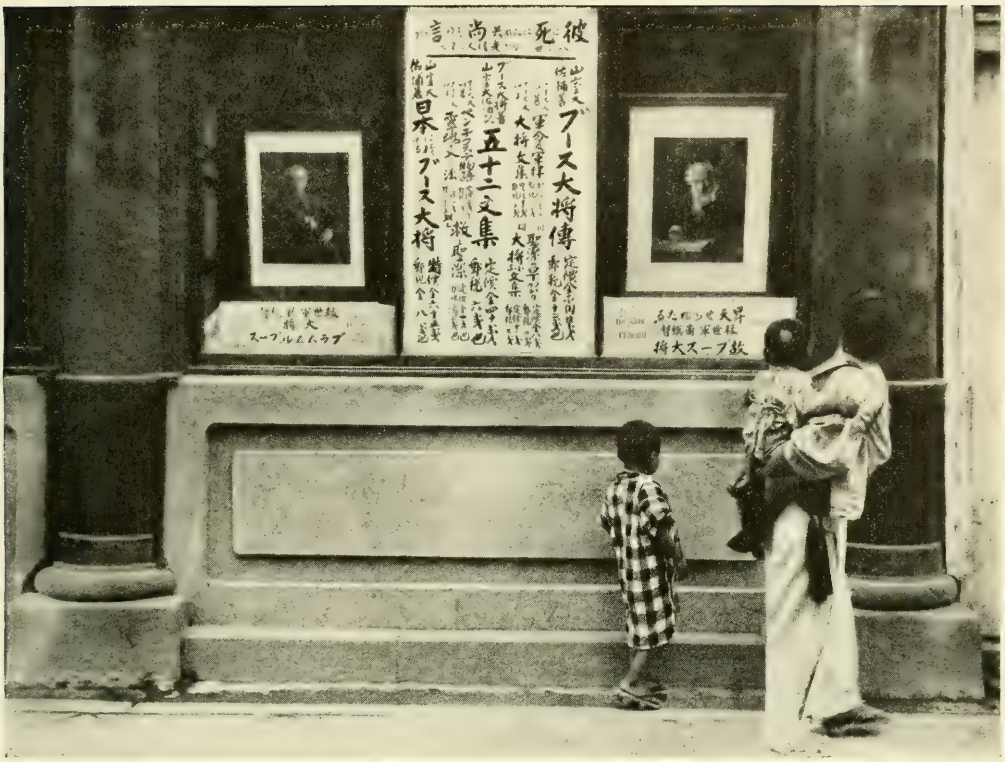
Very often the villagers keep the marchers with them and ask them for songs and music, and very frequently they ask for instruction in the Christian religion.

These marchers go far afield, reaching out to all classes in India, irrespective of the man-created caste system which has brought about conditions in the Far East not easy to overcome.

THE SALVATIONISTS AMONG THE CHINESE

Long before Christian missionaries went forth to fulfill the divine behest, "Preach the gospel to every creature," there existed a Chinese nation, with its vast possibilities for happiness and for good. Only the Egyptians, the Assyrians, and the Jews were their contemporaries.

Three and a half centuries have passed



THE ORGANIZATION'S HEADQUARTERS IN TOKYO: THE SALVATIONIST'S COUNTRY IS THE WORLD

"We recognize our brother in all the families of the earth."

since Saint Francis Xavier, in his dying hour, exclaimed in an agony of despair over his supreme discouragement in trying to evangelize China, "Oh, rock, rock, when wilt thou open?"

Years have passed since Napoleon, with far different motives, looked on the ancient century-defying nation and said, "The giant is asleep. Do not awake him."

But now the rock has opened, the giant is awake.

For years these people lay heavily on my father's heart. Their needs were continually discussed; they were the foundation of some of his most burning public utterances. He saw them in his dreams by night and thought and planned for them by day. Somehow I feel he still waits and watches for their salvation from the battlements of glory.

Our present General's deep and passionate interest in China is well known. All during the war the Army's blood-and-fire flag was raised beside that of the new Chinese Republic, while the work was steadily carried on by heroic men and women who labored as pioneers.

A new corps was recently opened in Peking. The hall is situated in the northeastern part of the South City, in the busiest commercial district. The building was formerly used as an old food shop. It has been remodeled until it can now care for about 250 people.

A VENTURE OF FAITH

Beyond the great wall, to the north of Tatungfu, lies Fengchen. Back in this robber-infested district the Army made its first venture of faith into the interior of China. No part of the earth is too far removed for the truth to reach it, and the Salvationists, unarmed and unescorted, trailed their way into the mountains to preach to brigands and robbers.

GENERAL WILLIAM BOOTH, THE GRAND OLD MAN OF THE SALVATION ARMY, ADDRESSING A MULTITUDE IN JAPAN
"Some men's passion is gold; some men's passion is art; some men's passion is fame; my passion is man!"

A STREET CORNER SALVATION ARMY MEETING IN THE HEART OF JAPAN

Twenty-one national governments recognize the inestimable service rendered by this organization, according it official financial support.

DISTRIBUTING RICE TO NEEDY KOREANS

The Salvation Army maintains that, as suffering recognizes neither race nor creed nor clime, human service should be equally cosmopolitan.

One of the few policewomen in China lives at Tatungfu, in the northern part of the Shansi Province. The Salvation Army made its first visit to Tatungfu a year ago, and now the town boasts this very progressive guardian of the peace, who delights in wearing a brass badge on her arm and in carrying a cane. It is her duty to see that small girls in the vicinity are not subjected to foot-binding.

Fifteen or twenty young girls from a near-by government school recently called upon the Salvation Army officers, who sang for them and taught them to sing a few choruses of simple hymns. They were greatly impressed. One of the girls admitted that she was interested, but she had always imagined that God loved only foreigners!

The territorial leader for northern China arrived in Peking early in 1918. He found 30 officers, who had been wrestling with the difficulties of the Chinese language for nearly a year, able to lead meetings and to give simple talks which could be understood by the people. They were eagerly waiting their appointments in the country of their adoption.

Very often our officers and cadets carry their beds with them, as the Chinese do when traveling. A thin mattress filled with cotton and a small coverlet and pillow are rolled into a case and carried as luggage.

Tientsin, the commercial capital of North China, recently opened three corps, with a contingent of nine officers, while Chengtingfu, a large walled city, and Men Lou, in the Shantung Province, have received officers and cadets.

The *War Cry*, issued by the Army press in China, is as popular over there as it is here. A song book has also been published containing translations of well-known popular Army songs.

THE ARMY TEACHES THE CHINESE TO SING

According to Western standards, the Chinese are not musical, but the Salvation Army has found a way to teach them to sing. A beginning is made by teaching songs to the children when a congregation does not seem to get the idea. Very soon the little ones are heard singing the favorite tunes of the Salvationists in the streets and lanes, and in this way they eventually have their elders singing with them.

During the winter of 1918 the Army did trencher duty for flood sufferers at Tientsin.

Korea is now receiving assistance from Salvationists sent especially for work in that country. Last winter rice was very high and the poor suffered greatly. The Army immediately established a free meal department and a station where rice and fuel could be purchased cheaply.

On account of the conversion of men who were formerly great drunkards, the wine shops in some of the villages of Korea lost so much trade that they were compelled to move to other places.

We started our operations in Korea in 1908. There are now 69 corps and outposts in that country, 106 officers, cadets and employees, and 175 local officers. At Seoul, in addition to the headquarters, there is a training garrison, citadel, and a school for girls.

In the East the translation of Salvation Army is "Army to Save the World."

LENDING A HAND TO THE LEPERS

It has often been said that the mass of men lead lives of quiet desperation; that what is called resignation is in reality "confirmed desperation." In its work around the world the Salvation Army has always thought first of the men who go about the day's business lost in the hopelessness of confirmed desperation.

There are men like that in the leper colony in Java, men who wait with grim certainty for the dark, dreadful, still years to pass. We have gone out to help them in order that these years may not be full of pitiful things. The men and lassies who go to these leper colonies can never come out.

They lay down their lives for those they go out to save.

Recently I received a report from a Salvation Army lassie who has spent four years in Java. The institution maintained by the Army at Boegangan cares for more than 360 patients, all native Javanese.

One Salvationist has already been smitten with the dread disease. Only by personal report can one visualize the need of these people. Last Christmas time we received this message from the officer in charge:

"We had a Christmas tree for them and they all received presents. Clothing was especially needed, as most of them have only one set of clothes, and when they wash these few rags they must wait for them to dry before dressing. Many of their clothes are in such a condition they are afraid to wash them, for fear there will be nothing left to put on.

"Of course, we have the poorest of the poor here at Boegangan; yet, with it all, I love my work."

When a lassie can face the world with such courage as that, in the midst of the greatest grief and loneliness human hearts can bear, where men live as outcasts, alone and forgotten by the world, we feel that our efforts are bearing fruit of untold value.

Even the Red Terror and Bolshevism could not keep the Salvation Army out of Russia.

Within three months after the opening of our work twelve outposts were established in various cities in Russia and several hundred soldiers and recruits, as well as thirty officers, were enlisted.

A training center for officers was started, two homes for refugee women and children were established, and a shelter for aged women opened. Since then our workers have installed five more corps.

Captain Larson, a Swedish officer, working from headquarters in Finland, was instrumental in forming the nucleus

WAITING AND WATCHING AT THE FRONT

Two Salvation Army girls standing at the door of their hut ready to cheer and minister to the World War soldier, whether wounded, weary, or homesick.

DOUGH FOR THE DOUGHBOY

It was not the Salvation Army doughnuts and pies themselves which won the hearts of American soldiers in France, but the spirit of good cheer with which the Salvation Army lassies rendered their every service.

of the Salvation Army in Russia at the time when its very existence was outlawed by the authorities.

In Petrograd our people are free to conduct meetings at the corners of the streets and in the parks.

FACING BOLSHEVISM IN RUSSIA

Unafraid of flying bullets, the Girl with the Tambourine sings and prays in the midst of street-fighting in Russia today.

One of our chief difficulties is that of traveling. Train service is unspeakable. Much of our work has been accomplished by traveling in sleighs in the winter time. Recently one of the lassies wrote to our headquarters in this country that a sleigh-driver informed her on one of these trips that all town lights must be out at 10.30, as that was the time set for the plundering to begin.

Trains so crowded that passengers had to cling to car couplings and precarious footholds on locomotives were a common sight. To spend the night thus, traveling in the bitter cold, in addition to other dangers, gives one some idea of the divine courage which it takes to carry the message through Russia during these dark days of fear and wild revolution.

In the early days of the Army in Japan, Colonel Gunpei Yamamuro, a native Japanese, wrote a book entitled "The Common People's Gospel." It was printed in native characters and had a phenomenal circulation among the masses, who thus learned, in the most direct sort of way, the first news of the gospel.

THE ARMY'S CRUSADE IN JAPAN

This book simply brought out once again the truth of Abraham Lincoln's assertion, that the Lord must have had a great love for the common people of the earth, otherwise He would not have created so many of them.

One of the first important accomplish-

"LIKE IT?"

Enthusiastic appreciation has come from the officers of the Allied armies in recognition of the services of the Salvation Army.

"YOU BET!"

But from the rank and file and from the mothers and fathers of the privates have come the most heartening tributes of gratitude.

ments in the land of cherry blossoms was the definite crusade against prostitution in Tokyo.

In the ultra-conservative Orient, for years prostitution had been looked upon as a social necessity. When Colonel Yamamuro understood what the Army had been doing for the protection of women all around the world, he decided that he would enlist its aid for the women of his own country.

He made a special appeal to the moral sense of the community. Then he prepared a special Rescue Edition of the Japanese *War Cry* and secured its entrée by thousands of copies into the segregated districts of the city. In the meantime homes were prepared for girls who might wish to change their mode of living.

A BITTER STRUGGLE AGAINST TRADITIONS OF THE EAST

Then began that long and bitter struggle against the traditions and customs of the East; but in the end the Army triumphed, with the help of the best elements in the ancient city. Today whatever of the "social evil" exists in Tokyo certainly exists as a voluntary and not a compulsory system.

Many of the prominent men in Japan are sponsoring the Army and all that it stands for.

For a period of ten years the Emperor has promised annual funds as an imperial contribution to further the work of the Army.

Relief-work was organized by the Salvation Army in Switzerland and in Italy for the benefit of the thousands of refugees who fled before the invading Austrians during the World War.

Officers were dispatched to Serbia to conduct relief-work, and when the Serbians began streaming into Italy, as early as January, 1916, the Army homes were crowded to their capacity. In connection with other work in the war zone, the Army organized to care for interned prisoners of war in Holland. This work later received special mention by the Dutch Government.

A new field recently entered by the Salvation Army is that opened in Portuguese East Africa.

At Bandoenig, Java, a new children's home has just been opened under the auspices of the Governor General's wife.

In connection with the Memorial Training College in Sweden, Commissioner Ogrim was successful in raising an endowment fund, to which the King of Sweden and Prince Bernadotte were among the principal contributors.

A WORLD CONGRESS OF SALVATION ARMY WORKERS

It was in 1883 that the Salvation Army first opened fire in South Africa. Now our organization is working in Zambesi, Rhodesia, and the desolate island of St. Helena. Seven industrial homes for women are now in operation in South Africa.

The story of the Salvation Army must be told as the history of a world-wide organization. Upon its flag the sun never goes down. There is a picture in my memory which illustrates this in a marvelous way. It is a picture full of wonderful color and brings back the gathering of our last international congress in Albert Hall, London.

There, under one great roof, 14,000 people were gathered from the ends of the earth, dressed as they were when the Salvation Army found them. The Zulu was there, with his shining brown shoulders and his loins girded with the skin of some wild beast of the snake-infested jungles; there was the yellow-skinned Chinaman, with the colors of his university, royal blue and dark yellow; there were the glossy-haired East Indians, with their scarlet cotton coats and yellow turbans; and Maori girls dressed in rainbow colors. The East Indians expressed all the Anglo-Saxon language they knew in the three words, "Salvation Army, hallelujah!"

DELEGATES IN WHITE FROM JAVA'S LEPER COLONY

In this picturesque gathering there were one or two who wore clinging snow-white garments. They came from the sad little island of Java, where Salvation Army men and lassies give their lives to help the lepers.

There were picturesque mountain-climbers from the Alps, with their staffs

SALVATION ARMY WORKERS OF SOUTH AFRICA AND SOME OF THEIR NATIVE ASSOCIATES

The South African field was entered by the Salvation Army more than thirty-seven years ago. The organization is now working in Zambesi, Rhodesia, and on the desolate island of St. Helena.

REVOLUTION AND STARVATION IN RUSSIA HAVE BEEN CLARION CALLS SUMMONING SALVATION ARMY WORKERS TO SERVICE

These refugees in Petrograd found among the Salvationists men and women "trained in the finest and most intricate of all arts, the art of dealing ably with human life."

A SALVATION ARMY JENNY LIND LEADING A STREET MEETING IN A SWEDISH CITY
No organization believes more strongly in the potency of song than the Salvation Army.

A SALVATION ARMY OFFICER OF PERU IN HIS PICTURESQUE UNIFORM
"Trained to obey orders willingly and gladly and wholly, not in part."

MEMBERS OF THE SALVATION ARMY IN SOUTH AMERICA WEAR RESPLENDENT REGALIA

But their service to their fellow-men is as simple, as earnest, and as self-sacrificing as is that of their brother workers in the slums of Shanghai and in the hills of Hindustan. The Salvation Army has been picturesquely described as a great empire—an empire without a frontier, an empire composed of fragments separated by vast stretches of land and immense sweeps of sea, but all bound together by the common cause of service to mankind.

and horns and their yodels, mingling their songs with the Germans, French, Italians, Scandinavians, South Americans, Canadians, Britishers, and 850 Americans.

Delegates were in that hall who came from Celebes, Sumatra, Costa Rica, Argentina, Cuba, Malta, Uruguay, Panama, Chile, Peru, Saint Lucia, Finland, and Antigua.

Out of this great mass of humanity our beloved General called to the front six little girls from the Criminal Tribes of India. They made a pathetic picture, with their little feet and legs bare, their slender forms wrapped in pieces of yellow cotton. As they stood before that vast audience they lifted up their dusky little faces and told the reason for it all in the song which they sang in broken English:

"Tell it again, tell it again,
Salvation's story repeat o'er and o'er,
Till none can say of the children of men,
Nobody ever has told it before."

WHEN THE FATHER OF WATERS GOES ON A RAMPAGE

An Account of the Salvaging of Food-fishes from the Overflowed Lands of the Mississippi River

By Hugh M. Smith

United States Commissioner of Fisheries

Photographs from the Bureau of Fisheries

ONE of the most important of the varied functions of the United States Bureau of Fisheries is a mighty effort to undo one of Nature's apparent blunders and mitigate the damage done annually to the prospective food supply of the country by a cataclysm involving untold millions of the best fishes in the Mississippi River and its tributaries.

This effort, yielding large practical results and coming at a period when there is most urgent demand for the prevention of waste and the maintenance of resources, must be rated as of great public importance and as worthy of general recognition and support.

The Father of Waters is a serious offender against the host of food and game fishes which populate its turbulent course, and exhibits marked disregard for the welfare of the entire fish tribe. Every year, and several times a year, it overflows its banks, wanders far from its proper haunts, and then subsides, leaving behind temporary pools, ponds, and lakes in which are myriads of young fishes whose destruction is inevitable unless human agency comes to their aid. Inasmuch as these fishes represent a large part of the future adult supply of all the leading species, their rescue and return to the main stream is a matter of the utmost importance.

For many years there has been a realization of this stupendous annual waste of food-fishes, and steps have been taken to repair some of that waste. It was only recently, however, that the efforts bore an adequate ratio to the magnitude of the task, and it was not until 1919 that the operations assumed a scope and yielded results that could be regarded as fairly commensurate with the need.

The annual freshet in the Mississippi River of greatest importance to the fisheries is the one known as the "June rise," which usually occurs about the time when most of the river fishes are ready to spawn. It is somewhat later than the freshet caused by the melting snows, but is usually of equal volume and represents surplus rainfall that is seeking a southern outlet.

PREHISTORIC GLACIERS CUT A WIDE VALLEY

In prehistoric times great glaciers, moving down from the north, seem to have cut a wide, deep valley through the upper reaches of the river, and through this passage frequent floods have for ages brought down and deposited silt and drift in such quantities that the main channel has been crowded from the center toward one of the precipitous banks on either side, while the remainder of what formerly constituted the river bed is now a low table-land, with a gradual ascent toward the hills.

It would appear that at one time the main river flowed unhindered through what is now wooded, lake-covered territory, and that great drifts gradually formed and divided the old bed into land-locked ponds, many parts of it with the lapse of time becoming so completely filled in as to provide secure anchorage for trees and other vegetation.

As the river rises it first submerges the adjacent lowlands, making ponds and lakes on the nearest levels; with its continued rise, lakes are formed at higher levels, and so on until the flood stage has

A TYPICAL FISH-RESCUE SCENE

Although this little bayou is still connected with the river by a shallow outlet, the rapid subsidence of the flood water would make it impossible for any of its fish inhabitants to escape into the river.

END OF A SEINE HAUL ON THE SHORE OF LARGE LAKE

The seine has been brought to shore and bunted, and the fish are being rounded up preparatory to sorting. Fish saved by this method can be transplanted in favorable waters for about one-thirtieth what it costs to rear the same fish in a pond-culture station.

SEINING UNDER THIN ICE

This is one of the most difficult operations in fish-rescue work, as small particles of ice become mixed with the fish. The rescue parties break the ice around the margin of the pond in order that the seine may be hauled under the frozen surface.

been reached, when depressions are often filled quite remote from the main channel.

Pursuing their natural instincts, the adult fishes at flood time leave the main channel and seek quiet back-waters in which to deposit their eggs. The eggs are laid under conditions that appear to be favorable for their development and for the hatching and growth of the young, and the latter may attain a length of several inches before the freshet begins to subside. With the recession of the flood waters, the adults turn their noses in the direction of safety and most of them ultimately reach the main stream. The young, however, fail to react promptly to the falling waters, and a very large proportion of them sooner or later are cut off and become permanently landlocked.

The temporary pools, ponds, lakes, and canals left by the subsiding flood waters are of various shapes, sizes, and depths. Some of them become dry in a few days; others may persist for weeks or months, while their water is gradually lost by evaporation and seepage; others, in smaller number, continue until winter, when they soon become solidly frozen.

YOUNG FISHES DOOMED TO DIE

The larger pools that survive the summer are often rich feeding grounds for the young fish, which grow with such amazing rapidity that many of them may attain a length of 8 to 10 inches by early November.

In any event, the fish contained in the landlocked waters necessarily die. The mortality may ensue quickly, as when a small pool becomes completely dry in a few days, or it may be gradual and long drawn out, as in a pond or lake of some acres area.

The frightful conditions that prevail as the water becomes reduced and the fishes more and more concentrated can well be imagined. The fishes' suffering from lack of water and air is usually aggravated by starvation, by the daily heating of the water by the sun's rays to a point that is almost intolerable and often fatal, by cannibalism, and by wading birds, snakes, turtles, mammals, and other fish-eating creatures from which there is no escape. The pools that persist until winter are so shallow that the fishes are killed by smothering, even if the water does not freeze to the bottom.

HOW THE FISHES ARE RESCUED

The work of salvaging food-fishes is simple, direct, and effective. It consists of netting the fishes from their unfavorable environment and depositing them in the open water of the Mississippi, and is accomplished by properly equipped rescue parties dispatched to the flooded districts from conveniently located bases or headquarters.

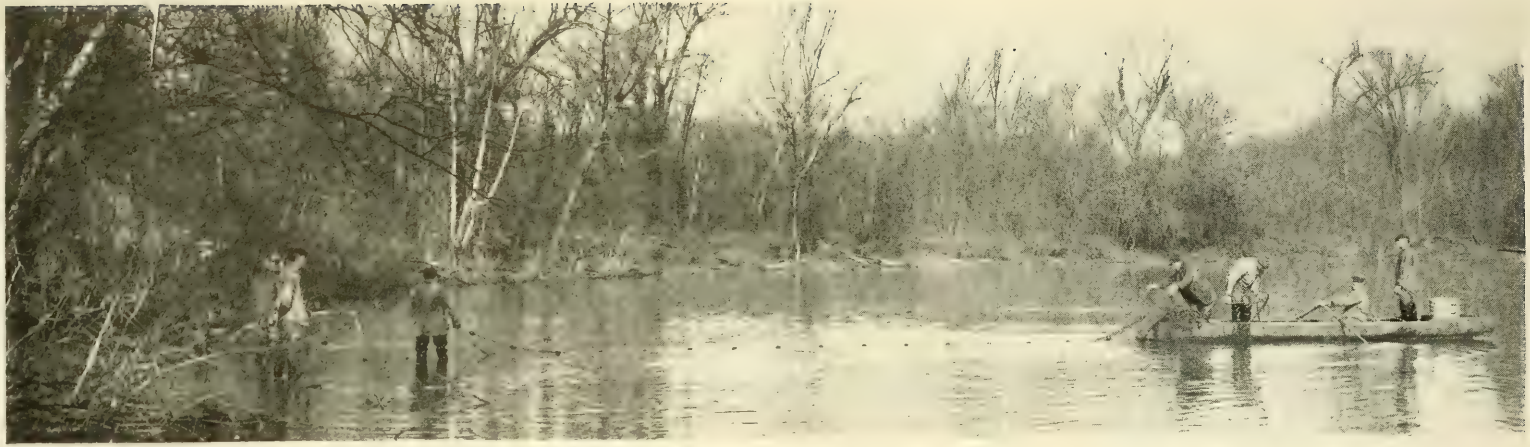
A government fish rescue crew consists of six to eight men, who employ a small launch in going to their field of operations and in returning to their base. The necessary equipment comprises fine-mesh seines of various lengths, small dip-nets, galvanized iron washtubs of one-and-a-half bushels capacity, tin dippers, and a flat-bottom rowboat.

The seining crews begin their work each season as soon as the floods subside sufficiently to disclose conditions. The active operations, as a rule, begin in July and continue in a given section until the allotted task is accomplished or the waters freeze, usually early in December.

The size and depth of given waters determine whether the men shall set their seines by wading or from a boat. As the net is carefully hauled and bunted, the fish are sorted into tubs, then carried as soon as practicable to the nearest point at which open water may be reached and there liberated.

The cut-off waters are for the most part in the bottom lands on both banks, usually within a few hundred yards of the river. In some sections, however, where the surface configuration permits a wide lateral dispersal of the flood waters, the temporary ponds that demand attention may be several miles back. It therefore happens that, while under ordinary circumstances the seining crew can easily carry the tubs of fish to the place of deposit, sometimes teams and motor trucks are employed.

Some of the landlocked waters are veritable lakes in which many seine hauls may be required to secure all or most of the fishes; others are so small that they may be thoroughly fished with a single



IN THE LARGER AND DEEPER PONDS, WHERE WADING IS IMPOSSIBLE, THE RESCUE CREWS SET THEIR SEINES WITH FLAT-BOTTOMED BOATS

LOADING CANS OF RESCUED FISH ON A TRUCK FOR SHIPMENT: ONCE PROPERLY HARDENED, A "FINGERLING" IS USUALLY A GOOD TRAVELER

haul of a short seine; and others are so extensive at the time of the first visit that they may properly be left for future attention when their size shall have become reduced to a point where thorough seining is possible.

156,657,000 FOOD-FISHES WERE RESCUED LAST SEASON

It may not appear to be a matter of great practical importance to know how many fishes of the different species are saved in the course of a season's work, but it is at least a matter of considerable interest to have such a record for each of the various sections of the river and for a series of years. Accordingly, the seining parties are under orders to make a count of the number of each species taken from each body of water.

The counting is done at the time the fish are lifted from the seines into the tubs with dip-nets. The tubs are half-filled with pure water, and fish of given sizes and species are counted into the tubs until the water level rises to a ring six inches below the top.

Subsequently, actual counting may not be necessary, but the number may be determined with sufficient accuracy by noting the water displacement. Frequent test countings are made in the course of the season, and a definite ratio of number to bulk is established for each average size of fish and each species.

When the weather is warm or the distance to the planting place is considerable, the welfare of the fishes densely crowded in the tubs requires that the water be kept well aërated. This is accomplished by dipping up a little water at a time and letting it fall back from a height of several feet, and is always aided by the squirming of the mass of fish, which keeps the surface water agitated and often frothy. Under the care of the vigilant and skilled fish men, the mortality among the rescued waifs while in transit is negligible, and when released the fish are healthy and active.

Throughout the entire length of the Mississippi River, except where the banks are protected by levees or where bluffs occur in proximity to the shores, the annual floods leave temporary lakes, ponds, and pools that contain food-fishes whose salvage is demanded.

The territory covered by the government's rescue operations in 1919 extended from Minnesota and Wisconsin to Arkansas and Mississippi. The places that were headquarters for rescue parties were Homer, Minn.; La Crosse, Wis.; Bellevue and North McGregor, Iowa; Quincy and Cairo, Ill.; Clarksville and Canton, Mo.; and Friars Point, Miss.

The record-making efforts in 1919 resulted in the saving of about 156,657,000 food-fishes. All parts of the river are not equally productive and all sections were not covered with the same degree of thoroughness. The territory reached from the base stations in Minnesota, Wisconsin, and Iowa yielded by far the largest returns in rescued fishes. There the conditions are especially favorable for an enormous annual destruction, and the need for salvage work is most pressing.

All the major and many of the minor food-fishes of the river are represented on the lists of those saved. Predominating in numbers are the staple fishes, which support commercial fishing and contribute largely to the food supply of the region, notably the buffalo-fishes, carps, catfishes, pikes, crappies, sunfishes, and perches.

Among the rescued game fishes the large-mouth black bass holds an important position, and with it may be classed also the crappies, rock bass, white bass, and various other excellent fishes which, while taken for market, are much sought by anglers throughout the Mississippi Valley.

THE FOOD-FISHES SAVED ARE WORTH MILLIONS OF DOLLARS

The young fishes that are salvaged and replanted in the parent stream are of rapid growth. A few of them may attain marketable size in the year after their rescue, and all of them are likely to be available for human use in two or three years.

The most critical period in the life of fishes is during a few weeks immediately after hatching. For most of the fishes rescued the principal danger from natural enemies and physical catastrophes

CLEANING UP A SMALL POND

Just as millions of dollars of taxes are made up of the pennies collected on small purchases of soda water and movie tickets, so 156,657,000 fishes were rescued from landlocked ponds, many of them, like this one, little more than puddles after the waters subside. Thrift in such little things makes national wealth.

SEINING A SMALL POOL, POSSIBLY SIXTY FEET WIDE; FOUR MONTHS BEFORE IT COVERED ABOUT TWELVE ACRES

When visited by a rescue party in November the pond had seeped and evaporated until it was 14 inches deep, and was easily handled with a 25-foot seine. Ten kinds of fish, aggregating 150,000, were saved. (See NATIONAL GEOGRAPHIC MAGAZINE for June, 1916, page 572.)

WASHING A MUD-CLOGGED SEINE IN A SHALLOW BAYOU

Some of the landlocked pools and bayous have soft, muddy bottoms, and when the seine is hauled in, fish and mud are mingled in a dense mass. By lifting the lead line and moving the seine away from the shore, a gentle rocking motion of the net easily rids the seine of mud.

has passed, the degree of safety depending largely on the size attained.

In the opinion of State and Federal fish culturists familiar with conditions in the Mississippi Valley and experienced in the rearing of the local fishes, at least 25 per cent of the fishes rescued may be expected to survive to a marketable or legal size, and will reach an average weight of not less than one and a half pounds in two or three years. Assuming that all the surviving fishes will then be caught for market and sold by the fishermen at the prices prevailing for the respective species in the local markets in December, 1919, the fishes salvaged by the Bureau in 1919 are estimated to have a prospective value of $6,527,000.

THE COST OF THE WORK IS SURPRISINGLY SMALL

The fish-rescue work, however beneficial from the standpoint of fish conservation, would hardly be justified if the

SORTING AND COUNTING A SMALL SEINE HAUL

It is a matter of interest to know the relative abundance of the different kinds of food-fishes in different parts of the Mississippi Valley and to be able to determine the unit cost of operations. In 1919 the actual outlay for saving this valuable food supply was about 1/50 of a cent per fish.

expense were disproportionate to the value of the results. It is therefore proper to note that the unit cost is only nominal, and even the total money outlay for operations of the magnitude of those in 1919 is surprisingly small.

Five years ago, when this work was undertaken on a limited scale and involved the salvaging of less than 2,500,000 fishes, the average cost per thousand fish saved was $3.18. In 1919, owing partly to the magnitude of the operations and partly to increased efficiency and better organization, the average cost per thousand was reduced to less than 20 cents. The cost in some of the less productive fields, where fixed overhead charges were applied to a comparatively small output, was somewhat higher, but 75 to 80 per cent of the fish were rescued and replanted at a cost of only 13 cents per thousand.

PLANTING RESCUED FISHES IN THE RIVER

At least one-fourth of the fishes rescued may be expected to survive to a marketable or legal size, and will reach an average weight of not less than one and a half pounds in two or three years.

IN A MISSISSIPPI RIVER JUNGLE

A government fishing crew going through a dense section of Mississippi River bottom land with their tubs full of rescued fishes, to be planted as soon as the river is reached. Only six of these rescued fish in a thousand are planted outside of the Mississippi basin.

A SEINING CREW ON THE MARCH

The party is proceeding in late autumn between two isolated lakes in a wooded bottom. In summer the small ditch was full of water and the lakes were connected with the river. The crew is here seen hauling a small boat from one lake to another.

Throughout the Mississippi Valley—in the States of Minnesota, Iowa, Kentucky, Tennessee, Missouri, Arkansas, and Mississippi—as well as in various other States, there are Federal establishments known as pond-culture stations, at which are reared some of the same fishes that are rescued in the salvage operations along the river, the principal species handled being the black basses, crappies, sunfishes, and catfishes.

The peculiarity which distinguishes these stations from the ordinary hatcheries is that the ripe eggs are not taken from the fishes by the fish-culturist, as in the case of trout, salmon, whitefish, shad, etc., but the fishes are allowed to spawn naturally.

Most of the pond fishes make nests and guard their eggs and young. It is therefore usually the case at these stations that a relatively large proportion

RETAINING STATION AT LA CROSSE, WISCONSIN

At this little adjunct of the rescue work, on the Mississippi River in southwestern Wisconsin, 150,000 salvaged fishes may be held for hardening, pending shipment to interior waters. When first rescued from landlocked waters the young fish cannot undergo the strain of a long railway journey.

of the progeny of a given pair of fishes is reared to a stage where the young are able to take fairly good care of themselves, although the actual number produced is small.

The results of the operation of pond stations are of interest because of their bearing on the value of the rescue work. It may therefore be noted that the common practice among both Federal and State fish-culturists is to distribute pond fishes after they have been reared to a "fingerling" size. A fingerling is less than one year old, and may be from one to six inches long when planted.

The average length of the pond fishes sent out from the nurseries is two to three inches. A government pond station may produce, rear, and plant from 250,000 to 1,000,000 such fishes in a season, and the combined output of six typical stations in 1919 may be placed at 2,725,000—a cost of $5.50 per thousand.

From these figures it appears that the number of fishes rescued in 1919, if they had been produced and reared in the ordinary way at established plants, would have required 345 pond stations and the actual cost of production would have been about $860,000. To this sum, however, should be added the year's cost of the regular station staffs and general charges for maintenance, which would have been over $2,000,000.

There should also be taken into consideration the initial cost of construction of the pond stations, estimated at not less than $12,000,000. Against these large hypothetical charges is to be placed the actual aggregate cost of the salvage operations in 1919, namely, $31,000.

THE PEARL BUTTON INDUSTRY EMPLOYS 20,000 PEOPLE

The perpetuation of the fish supply in the Mississippi and its tributaries involves a very important industry besides fishing. Investigations conducted for the Bureau of Fisheries years ago showed an intimate relation between certain kinds of fishes and the mussels, which yield valuable pearls and support a pearl-button industry which gives employment to about 20,000 persons and has a product worth from $5,000,000 to $6,000,000 annually.

The young mussels, of microscopic size when thrown off by their parents in

Photograph from H. C. Frankenfield

PART OF THE CAIRO, ILLINOIS, DRAINAGE DISTRICT UNDER FLOOD WATERS

The last thing that one would expect to rescue from a flood are the fishes, yet amid all this desolation there are those who are far-sighted enough to save landlocked fishes after man has saved what he can from his water-logged home.

myriads, need to pass the first few weeks of their independent existence on the gills of fishes. If the fishes are not present at the proper time, the mussels cannot survive. Furthermore—and this is a most interesting feature of the co-relation of fishes and mussels—the young of particular kinds of mussels require the gills of particular kinds of fishes as nurseries.

The black bass is host for several sorts of mussels, the crappies for several others, the catfishes for others. The skip-jack, a kind of herring, is the only known host for the best of all mussels; and as this fish is not by any means abundant, its maintenance is of prime importance to the welfare of the button industry. In 1919 more than one and a half million skip-jacks were rescued.

AN IMPROVEMENT ON NATURE

The peculiar requirements of the young mussels having been carefully determined, the Bureau of Fisheries has gone extensively into the business of artificial propagation of pearly mussels by a method which is a vast improvement on nature. The spawning mussels, held in ponds, are at the critical period provided with the special fishes needed for the attachment of the young. The fishes obtained in the rescue operations are turned into the ponds at the time the mussels are spawning and become thickly inoculated. They are then liberated in the open water and distribute themselves and the mussels throughout a wide stretch of river. Thus two important branches of the Bureau's work go hand in hand.

The artificial propagation of freshwater mussels is one of the functions of the United States Fisheries Biological Laboratory located on the Mississippi River near Fairport, Iowa. Each year from 200,000,000 to 300,000,000 young mussels are thus brought in contact with the gills of rescued fishes and given a proper start in life. The maintenance of the mussel supply is thus being greatly aided.

That this work is not a mere experiment, but is yielding practical results, is shown by various pieces of evidence. For instance, pearl buttons have been made from Mississippi River mussels grown from larvæ that had been artificially implanted on the gills of a black bass less than two years before and had been under constant observation. These mussels would have attained full commercial size at the age of four and a half years.

DISTRIBUTION OF FISHES TO OUTSIDE WATERS

This account of the rescue work would be incomplete if no reference were made to the sending of small numbers of salvaged fishes to waters more or less remote from the Mississippi. These fishes serve the same purpose as do the product of the hatcheries. They are intended for replenishing depleted waters or for stocking newly formed lakes and ponds that may have no fish life or no suitable supply of food or game fishes.

Fishes as taken from the landlocked waters of the Mississippi Valley are not in a condition to stand distant shipment. It is therefore necessary to subject them to a hardening process before it is safe or wise to send them on a long railway journey. The hardening is done at several depots along the river, notably at La Crosse, Wis., and Bellevue, Iowa. At these and several other points are small buildings containing tanks in which the fish are kept, without food, in cool, clear, running water for several days.

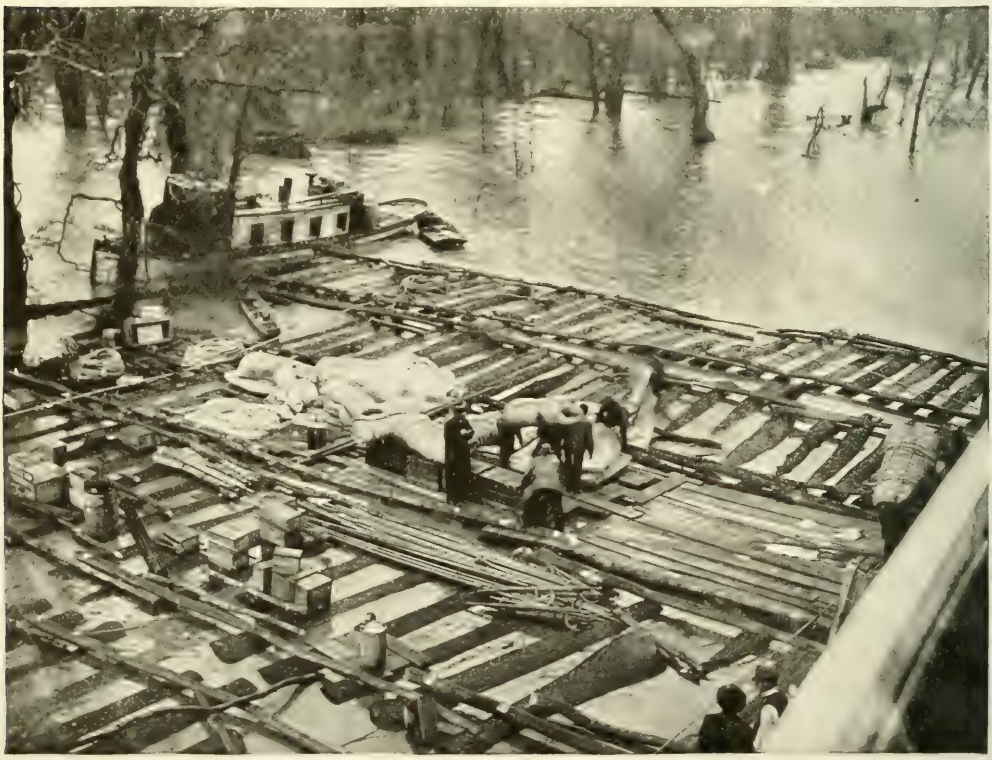
The fish, then ready for shipment, are placed in large cans and loaded into railway cars, in which they make their journey in safety and comfort. Minor shipments for short distances may be made in baggage cars, with an attendant.

The new all-steel distributing cars of the Bureau of Fisheries embody the very latest ideas in fish transportation. These cars, with their permanent crews and with all modern improvements for keeping fish supplied with water and air, are hauled on fast passenger trains and have been used for forwarding from the Mississippi the special lots of rescued fishes designed for planting in adjoining States.

Sometimes a car-load of fish may be taken in its entirety to a single point of deposit, but more frequently detachments are delivered *en route* to applicants who have been notified in advance, by mail or telegraph, to meet a given train with receptacles for taking their fish away.

A BROKEN MISSISSIPPI RIVER LEVEE AT LUCCA, ARKANSAS

Not only Holland and the Acadian home of Evangeline have protected themselves by dikes, but scores of the great rivers of the world are paralleled by earthen or stone embankments.



Photograph from H. C. Frankenfield

REFUGEES ON LOG RAFT AT NEBLETT, MISSISSIPPI, WAITING FOR A STEAMER

Face to face with a common peril, the people of the flooded districts unite in building log rafts that, with the arrival of more refugees, come to have as many necessaries and such luxuries as the Swiss Family Robinson salvaged from the wreck.

Photograph from H. C. Frankenfield

FAMILY ARKS IN WHICH REFUGEES FROM A MISSISSIPPI RIVER FLOOD SEEK SAFETY AFTER THE DESTRUCTION OF THEIR HOME: MODOC, ARKANSAS

Lest there may be created the impression that large numbers of salvaged fishes that should be returned to the parent stream are being diverted to outside waters, it may be stated that in 1919 less than six-tenths of 1 per cent of the fishes saved from the Mississippi floods were consigned to outside waters. This altogether negligible number consisted chiefly of catfishes, sunfishes, crappies, and basses.

From what has already been stated, it must be apparent that this work on which the fisheries service of the Federal Government has voluntarily embarked is of very great value, not only to the States immediately concerned, but also to distant parts of the country, for the food-fishes of the Mississippi basin receive a wide distribution in the trade. As a matter of fact, the importance of this effort as a means of maintaining and increasing the food supply of the country can hardly be equaled in any other field when cost, certain results, and quick returns are taken into consideration.

In most of the States bordering on the Mississippi there is a growing public interest in and urgent demand for a continuation and extension of the rescue work; and along the Ohio, Missouri, and other tributaries of the Mississippi,

Photograph from H. C. Frankenfield

REFUGEES ON A MOUND AT MODOC, ARKANSAS, JUST BELOW THE SCENE OF A CREVASSE IN GARDINER'S LEVEE ANGLE

where there prevail essentially the same conditions as in the main stream, the desirability of this form of food conservation is being seriously considered.

In the districts now only partly covered and in the sections where up to this time it has been impossible to undertake any operations, there exists an opportunity for very productive work. There are unbroken stretches of river 500 miles in length, where the floods are yearly causing large sacrifice of food-fishes, on which no attempts at rescue have heretofore been made because of lack of funds and personnel, and the major tributaries of the Mississippi present a virgin field of unknown possibilities.

It should be understood that Congress does not appropriate funds especially for this particular work, and that the money now employed is in reality part of a general appropriation for fish culture, and the persons and equipment detailed for the rescue operations are temporarily drawn from other branches of the service.

What is needed, in order that this service may be conducted in a manner and on a scale that its importance justifies, is specific recognition by Congress through the providing of special funds and personnel, so that the work may not be contingent on the necessities of other duly established activities.

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COMMON MUSHROOMS OF THE UNITED STATES

BY LOUIS C. C. KRIEGER

Continuing its policy of presenting to its readers comprehensive and especially timely articles and illustrations in color which stimulate a keener interest in and a more satisfying enjoyment of the glories and wonders of Nature's forests, plains, and hills, the NATIONAL GEOGRAPHIC MAGAZINE *publishes the accompanying series of matchless mushroom paintings and intimate descriptions by L. C. C. Krieger, who is associated with Dr. Howard A. Kelly, of Baltimore.*

The delicacy of coloring and variety of hues, the curious forms and astounding fertility of mushrooms, will amaze the reader. It is believed that Geographic members will take the same delight in their "Mushrooms" Number that they have expressed previously in such Nature-study numbers as "Birds of Town and Country," "American Game Birds," "Mankind's Best Friend—The Dog," "Our State Flowers," "Wild Animals of North America," etcetera.

The reader is especially cautioned, however, that the illustrations and text MUST NOT *be used as final authority in deciding whether a particular specimen is an edible or a poisonous fungus, because no treatise within the limits of a single number of even* THE GEOGRAPHIC *could be sufficiently detailed and complete to protect the novice against the deadly species, which are very numerous. For those who desire more detailed description of mushrooms, this article is being amplified with much technical data and can be obtained separately, bound in cloth, at $3.00 per copy, postpaid.*

MORE than thirty-eight million pounds of edible mushrooms were imported into our country during the five years immediately preceding the World War. In addition to this vast amount, we consumed not only the large output of our own growers, but quantities of wild species besides.

The species imported from France comprise the cultivated variety of the common meadow or pasture mushroom, *Agaricus campester* (for illustrations see Plate I and page 400); the expensive truffle; the cèpe (*B. edulis*, illustrated in Plate IV and on page 406).

China sends us certain species largely for the use of her own people resident among us. Our own producers limit themselves to the cultivated variety of the meadow mushroom.

The names of the wild species marketed cannot be ascertained definitely, since there is with us no such legal control of the sale of mushrooms as obtains in most cities in continental Europe. Gatherers in the United States either eat their finds themselves or sell them promiscuously to any mushroom-hungry individual who has the temerity or the knowledge to venture purchasing.

Photograph by A. G. and B. Leeper

ONE OF THE POISONOUS MEMBERS OF THE AMANITA MUSHROOM FAMILY

The top view of the specimen on the right shows that the deadly Amanitas peel as readily as the edible mushrooms. "Peeling" is, therefore, no sign of edibility.

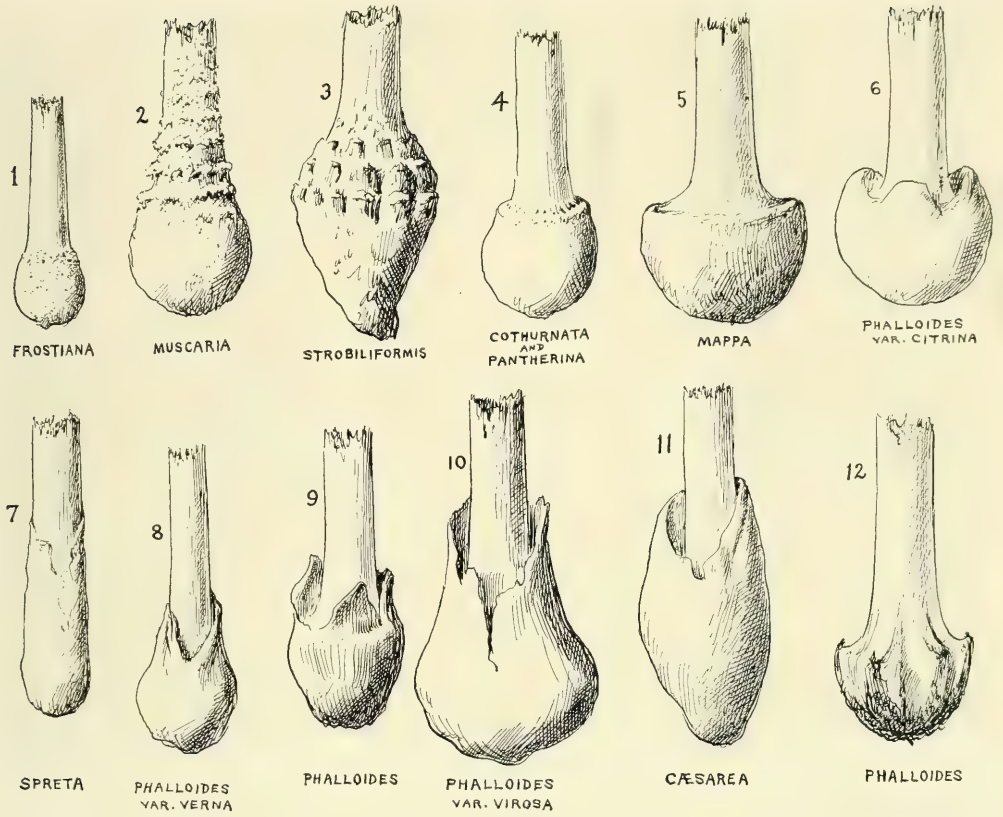
From personal observation, however, and from a perusal of the popular literature which advises the consumption of certain species, we may judge that the following species most frequently find their way into the kitchen: *Agaricus campester, Agaricus arvensis* (see Plate I), the Parasol mushroom (*Lepiota procera,* see Plate XIV), certain species that grow on trees (*Pleurotus ostreatus,* etc., see page 402), ink-caps (species of Coprinus, see Plates VIII and XII), "fairy-ring" mushrooms (see page 397), puff-balls (pages 414-419), and, of course, Morels (Plate VII and pages 420, 421).

Since the establishment of mushroom or mycological clubs in some of our large cities, considerable interest has been aroused, with the result that members and their friends have learned to recognize many of the lesser known, yet equally safe and good species. The war, too, has had its effect. Food is scarce and high-priced, and people, following suggestions offered in the public prints, are turning to hitherto unknown or disregarded sources of food supply, including the spontaneously growing crop of wild mushrooms.

RATTLESNAKE DENS VERSUS POISONOUS MUSHROOMS

But those who, unadvised or ill-advised, would gather wild species for the table should remember that they are embarking upon an adventure that may lead to a sudden and horrible death.

To ask a person to gather his own mushrooms for the table, without previous instruction that will enable him to avoid the deadly kinds, is equivalent to, if not worse than, inviting him to put his unprotected hand into a den of rattlesnakes. Indeed, of the two risky performances, the latter would be the safer; for there are at least two known antidotes for rattlesnake venom, whereas there is none for the poison or poisons of the exceedingly common *Amanita phalloides* (see Plates X and XVI) and its multitudinous forms and varieties.



THE DANGER SIGNALS, OR DEATH-CUPS, WHICH NATURE PLACES ON THE BASES OR UNDERGROUND PORTIONS OF THE AMANITA SPECIES

The death-cup is technically knowu as the volva and at first encloses the entire plant just as the egg-shell does the egg. As the plant grows the stem lengthens, and in doing this ruptures the bag. The illustration shows how the death-cup, or volva, differs in structure with the various species of Amanita. There are two distinct types of death-cups, the bag-like type (Nos. 10 and 11), and the more or less fragile, crumbling, or scaly type (Nos. 1, 2, and 3). Both types are subject to variation, the variations being characteristic for different species or groups of species. Number 7 represents a diabolical attempt on the part of one Amanita to camouflage its identity, both bulb and bag-like volva being difficult to discern. A reduction of the "friable" (crumbling) type of volva is seen in No. 1, only a few grains being left to tell the tale, and sometimes even these are absent. When absent from the bulb, however, they are usually to be found on the ground, leaves, twigs, or needles immediately surrounding the base, or on top of the cap, where they form warts, provided rain has not washed them away. The beautiful *Amanita cæsarea,* Plate IX, and the Blusher (page 390) are two exceptions in the dangerous Amanita family, being edible though possessing death-cups.

In this connection it is of interest to note that poisonous serpents and fungi were associated in the mind of man from early times.

Pliny writes: "Noxious kinds must be entirely condemned; for if there be near them a hobnail or a bit of rusty iron or a piece of rotten cloth, forthwith the plant, as it grows, elaborates the foreign juice and flavors into poison; and country-folk and those who gather them are alone able to discern the different kinds.

"Moreover, they imbibe other noxious qualities besides; if, for instance, the hole of a venomous serpent be near and the serpent breathe upon them as they open, from their natural affinity with poisonous substances, they are readily disposed to imbibe such poison. Therefore one must notice the time before the serpents have retired into their holes."

Were it not that the subject is such a serious one, we should feel inclined to laugh at the simplicity of the ancients.

Photograph by A. G. and B. Leeper

THE BLUSHER (*Amanita rubescens*) IS EDIBLE

There are many thousands of species of mushrooms and many strange forms, as the succeeding photographs show. The collector observes especially variations in the cap (1), gills (2), ring (3), stem (4), volva (see page 389), and color of the spores (for an account of these marvelous reproductive bodies, see pages 392, 402, 415).

Though edible, the Blusher is a member of the dangerous genus Amanita, and should therefore be eaten only by those who are thoroughly familiar with a large number of Amanitas. Its volva has disappeared into warts on the cap, see description of figure 1, page 389. It may be yellowish, entirely white, and often very much deformed or aborted in shape, and quite frequently specimens are found that refuse to "blush." The Blusher is found in thin and dense woods, solitary or scattered; time, July to September; distribution, United States, east of the Mississippi, and in Europe. About natural size. For color figures of Amanitas, see Plates II, V, IX, X, XV, and XVI.

Curiously enough, some of the ancient beliefs as to the origin of poisonous fungi persist at the present time in Italy. A Sicilian laborer whom the writer interrogated on the "funghi," vouchsafed the "information" that the poisonous kinds grow from rusty iron (nails, etc.) in the ground, but that they are easily to be distinguished from the wholesome kinds in the process of cooking by simply dropping a piece of bright silver (a new coin or the like) into the stew: if the fungi are poisonous, the silver will blacken; if not, it will retain its luster. The efficacy of this "test" is believed in by an astonishing number of people.

But not only tradition is active in promulgating error in this life-and-death matter. Newspapers occasionally and inadvertently publish "general rules" that are often misleading. For example, an article in a representative daily in one of our large cities, after assuring the reader that there are but six poisonous kinds among more than a thousand, adds:

"No poisonous mushroom is ever found growing in cluster form."

In refutation of such a generality, the reader is referred to the symptom produced by *Clitocybe illudens*, a poisonous, though not a deadly poisonous, agaric that grows in dense clusters (see Plate III and text, page 403).

GENERAL RULES FOR BEGINNERS

General rules for the guidance of mushroom-hunters are trustworthy and serviceable only when formulated by experienced botanists. The following six rules* by the late Dr. W. G. Farlow, Professor of Cryptogamic Botany in Harvard University, will prevent, if scrupulously observed, the eating of notoriously poisonous species:

"(1) Avoid fungi when in the button or unexpanded stage; also those in which the flesh has begun to decay, even if only slightly.

"(2) Avoid all fungi which have death cups, stalks with a swollen base surrounded by a sac-like or scaly envelop, especially if the gills are white. (Study the Amanitas and diagram, page 389.)

"(3) Avoid fungi having a milky juice, unless the milk is reddish.

"(4) Avoid fungi in which the cap, or pileus, is thin in proportion to the gills, and in which the gills are nearly all of equal length, especially if the pileus is bright-colored.

"(5) Avoid all tube-bearing fungi in which the flesh changes color when cut or broken or where the mouths of the tubes are reddish, and in the case of other tube-bearing fungi experiment with caution.

"(6) Fungi which have a sort of spider web or flocculent ring round the upper part of the stalk should in general be avoided."

Professor Farlow adds that "Rules 1, 2, and 5 may for the beginner be regarded as absolute, with the exception to Rule 2, *Amanita cæsarea* (Plate IX), the gills of which are yellow. Rules 3, 4, and 6 have more numerous exceptions, but these rules should be followed in all cases unless the collector is content to experiment first with very small quantities and learn the practical result."

Other rules that will help to protect from serious poisoning are:

Do not collect mushrooms in or near wooded areas except for study purposes.

This rule is very general, as it does not protect against the green-gilled Lepiota (see illustration on page 393), nor against an occasional Amanita and some others; but it does prevent the beginner from entering the very "lair" of the man-killers.

Do not accept mushrooms from a self-styled expert, even if you have to disoblige a dear friend. Learn the subject yourself.

That an animal (insect, squirrel, turtle, etc.) has eaten of a mushroom is no criterion of the edibility of that mushroom for man. Insect larvæ thrive and grow fat on the violently poisonous *Amanita phalloides* (Plates X and XVI).

Soaking or boiling in water does not render a poisonous species edible.* The poisons of *Amanita phalloides* are destroyed only by continued boiling in powerful acids. (Dr. W. W. Ford.)

* Published in Bulletin No. 15, U. S. Dept. of Agriculture, Washington, D. C.

* J. Henri Fabre, in his "The Life of the Fly," relates that the peasants of Sérignan, in the south of France, render such notoriously poisonous species as *Amanita pantherina* and *Amanita citrina* (Plate V) edible by parboiling in water. Other reliable evidence speaks against this practice, however.

The truth is that inviting any one to become a mushroom-eater is tantamount to asking that person to become somewhat of a botanist, assuming, of course, that one has no ulterior motives on his or her life.

HOW WE MAY ACQUIRE THIS KNOWLEDGE

The preceding paragraphs are likely to dampen the ardor of those who would be pleased to learn how to collect and select their own mushrooms, but who are not sufficiently interested to go to the length of acquiring the necessary knowledge that will enable them to do this with safety. Those who are so affected had better do without mushrooms for the rest of their lives, bearing in mind that, so far, there is no "player attachment" to the study of mushrooms.

The most expeditious way of acquiring this knowledge is to join a mushroom club, if there happens to be such an organization in the city of one's residence. Boston, Philadelphia, Washington, and Detroit have, or have had, such clubs.

MUSHROOMS ARE THE FRUIT OF FUNGI

The removal of the bark from a rotting tree-trunk or the disturbance of the dense mat of decaying leaves on the floor of the forest will reveal fine threads, usually white in color. These threads may be loosely scattered and mould-like, compacted into a dense meshwork of cords, or spread out in flat sheets of the texture of white kid leather. In old mines the timbers are often festooned with long streamers of this soft substance, which to botanists is known as "mycelium," to mushroom growers as "spawn."

As every one who has cultivated these plants knows, mushrooms grow from these threads, not, however, as the apple tree grows from its roots, but rather as the apple grows on the tree, for the mycelium is the plant, the mushroom the fruit.

THE MARVELOUS SPORES

Every mushroom species arises from a mycelium of its own; yet, to distinguish between species, students rely exclusively on the forms, colors, and microscopic characters of the fruit-body (the mushroom), the mycelium rarely presenting characters sufficiently distinct for identification purposes.

The forms of mushrooms are extremely varied, but all have in common the ripening and liberation of the microscopic spores ("seeds" or reproductive bodies), by means of which the species are enabled to spread over wide areas. Some of the remarkable qualities of these spores are told on pages 402 and 415.

The mushroom collector can make some interesting experiments with the spores, as follows:

If the expanded cap of the common pasture mushroom (*Agaricus campester*) (see Plate I) be removed from its stem and placed upon a sheet of white paper, gill side downward, and left there under cover of a finger-bowl for an hour or two, there will be formed a beautiful deposit ("spore-print") of the microscopic, purple-brown spores.

If an Amanita (Plates II, V, IX, X, XV, and XVI), a Lepiota (Plate XIV), a Tricholoma (Plate VII), a Clitocybe (Plate III), or an Armillaria (Plate VI) be treated in the same way, a white spore-print will result. With a Volvaria (Plate V) the deposit will be reddish or pinkish. Pholiotas (Plates VIII and XIII) and Cortinarii (Plate VII) will throw down spores of some shade of brownish yellow, rusty brown, or cinnamon. Coprinus (Plates VIII and XII) and Panæolus (Plate VIII) species precipitate black or blackish spores.

Similar experiments may be made with other varieties.

FUNGI IN NATURE'S ECONOMY

The Fungi, a class of plants of which mushrooms are the most familiar examples, play an important rôle in their influence on the higher forms of life. As parasites on plants, animals, and man, they cause destruction on an almost incalculable scale. As scavengers and as rock-disintegrators, on the other hand, they accomplish work that is basic for the very existence of all life.

Rock is the raw material of the farmer's soil; but before the farmer can have this soil it must first be made. How is it made?

Violent weather changes—heat, cold, rain, snow, and ice—start the breaking-up process. Associated with these agencies, the lichens begin their work. Dry, crusty things, these plants produce an

Photograph by C. Cramer

THIS GREEN-GILLED LEPIOTA (*Lepiota morgani*) IS POISONOUS

Beware of this false Parasol mushroom. It differs from the true edible Parasol mushroom (Plate XIV and page 439) in its greenish gills, coarser scales, and larger size. These two young specimens were photographed on a lawn in Washington, D. C. Approximately natural size. This Goliath of Mushrooms, the green-gilled Lepiota, is especially plentiful in the Mississippi Valley, but it also occurs in the Middle and South Atlantic States, in South America, in the West Indies, and probably in Bohemia and in the Philippines. Its habitat is in rich pastures, cultivated ground, in open woods, and on lawns in cities; time, June to October.

Photograph by George Shiras, 3d

THE EDIBLE HONEY-MUSHROOM (*Armillaria mellea*) "FINISHING" A TREE

This mushroom is the bane of the orchardist. The growth extended eight feet up the maple tree and four feet at the base (see text, page 411, and Color Plate VI, upper figure, and opposite page).

Photograph by George Shiras, 3d

"A TRAGEDY IN THE FOREST"

Armillaria mellea is here shown at its destructive work. This tree is doomed. This species of fungus is also shown as the upper figure of Color Plate VI and on opposite page. If you chop off the mushrooms, others will soon replace them, for they are simply the fruit of a parasite infesting the tree (see page 392 and the bracket fungus, page 409).

THE ABORTIVE CLITOPILUS (*Clitopilus abortivus*) AND ABORTIVE FORMS, THE LATTER SHOWN ON THE RIGHT. EDIBLE. ONE-HALF NATURAL SIZE

The eye that is sensitive to subtle color arrangements always meets with pleasure the unobtrusive habitant of our woodlands, known as the Abortive Clitopilus. When specimens are found, they are almost invariably accompanied by the odd, puff-ball-like masses, 1¼ to 2½ inches in diameter, irregular in shape, and of a whitish tint, shown in the right of the photograph. It would be interesting to ascertain whether these queer masses are caused by insects or by some parasitic fungus. An inspection of the interior will show that there is no differentiation of tissues into cap, stem, and gills. Similar masses are found accompanying the Honey mushroom (see Color Plate VI) and other species. Both the perfectly developed and the aborted forms are edible. They should be thoroughly cooked to bring out the flavor.

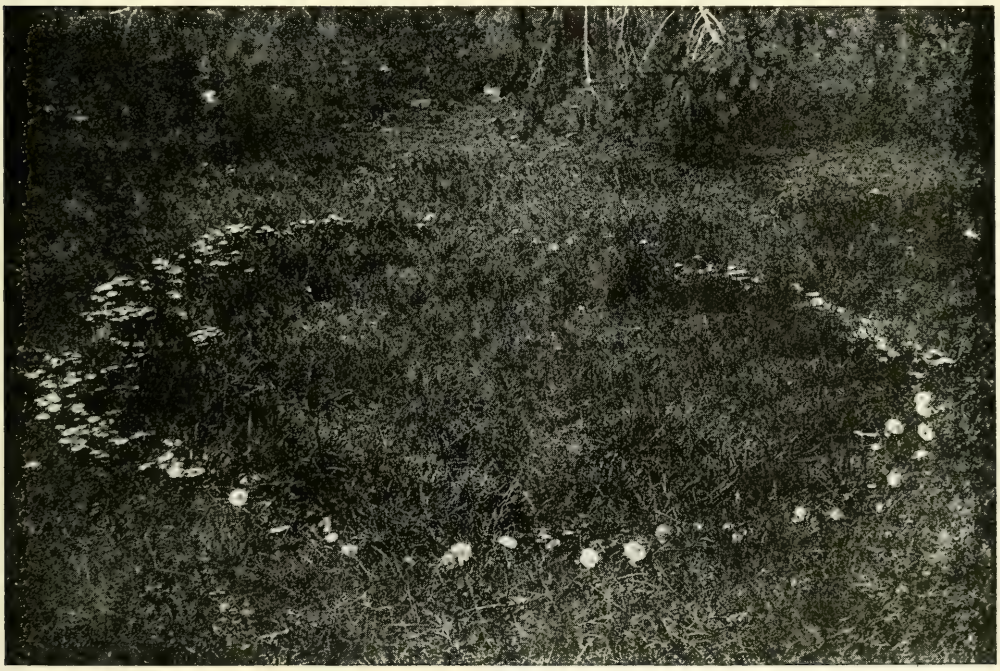
Photographs by A. G. and B. Leeper

THE GREENISH RUSSULA (*Russula virescens*). EDIBLE

The various Russulas are difficult to distinguish from each other. This species, however, is sufficiently well marked to be recognized by the layman. Painted with the hues of the rainbow, the Russulas bring a touch of brightness into the gloomy depth of the forest. Vivid reds, greens, purples, violets, and yellows predominating, these conspicuously colored agarics are at the same time the joy of the painter and the despair of the student who attempts their classification. The Greenish Russula grows in thin woods and in grassy, open places; time, July and August; distribution, Maine to Virginia, and west to Ohio and Michigan; also in Europe. About one-half natural size.

THE FAIRY-RING MUSHROOM (*Marasmius oreades*). EDIBLE

The specimens shown grew in the grounds of the White House, Washington, D. C. Approximately one-half natural size.



Photographs courtesy of U. S. Department of Agriculture

A "FAIRY-RING" FORMED BY *Marasmius oreades*, ONE OF THE BEST EDIBLE MUSHROOMS

The beginning of a "fairy-ring" may be a single mushroom which drops its spores or seeds in a circle about the base. The next season the small ring of mushrooms drops a larger ring of spores, and so the circle expands, year by year, exactly as the ripples spread out on the surface of a millpond when a rock is cast into the water. Fairy-rings, formed in Colorado, have been estimated to be about 600 years old. Legend informs us that these rings are the magic circles within which elves and other nimble fairy folk hold their revels at midnight on our lawns. There is another superstition that the rings mark the spots where bolts of lightning have struck the ground. *Marasmius oreades* is found in grassy places (lawns, pastures, and by the roadside) from May to October, being widely distributed in both the North and South Temperate zones.

THE VELVET-STEMMED COLLYBIA (*Collybia velutipes*). EDIBLE

In winter time the mushroom lover yearns for a taste of wild species. This he may have if he will be on the lookout for this tree-inhabiting Collybia. About one-half natural size. With its stem encased in a suit of dark-brown velvet, its rich yellow cap protected by a mucilaginous covering, the plant is admirably adapted to stand the rigors of the boreal season. This mushroom is gathered in the spring, autumn, and winter; distribution, eastern United States as far west as Kansas and Iowa; probably in the Pacific Coast States; also in Europe and Mexico; a variety (*spongiosa*) in Alaska.

Photographs by A. G. and B. Leeper

THE ROOTED COLLYBIA (*Collybia radicata*). EDIBLE

With its yellow-brown, wrinkled caps perched on a tall stem, this Collybia is met with almost immediately one enters a beech or pine forest. About one-half natural size.

acid that crumbles the hardest rock. Rains wash the disintegrated particles into cracks, crevices, and crannies down a slope. The remains of the dead lichens are added to the débris to form the first beginnings of soil in which other lichens, small ferns, and seed plants find a place to thrive and eventually die, each plant leaving behind some small particles of matter. Gradually, with infinite patience, Nature thus deposits soil in the valleys.

Ages of this slow but cumulative work, in which soil bacteria and other fungi play an essential rôle, and we have rich, virgin soil ready to receive the precious grains of wheat. Then the eye of hungry man is gladdened by the sight of acres of the golden crop.

FUNGI RAISE THE DOUGH

Bread made from unleavened dough is not to the taste of most of us. It must be light and spongy to be palatable. To obtain these qualities we are again dependent on the fungi. The good housewife buys yeast, dissolves it in water, and adds the fluid to the heavy dough, which is then thoroughly kneaded and set aside overnight in a suitable temperature. The next morning she is pleased to note that the dough has risen. After further kneading, it is placed in the oven and baked into appetizing loaves. On being cut, the bread exhibits a multitude of small bubbles of nearly equal size.

The little Brownies that labored while others slept are microscopic fungus cells that were introduced with the yeast. Given sugar, starch, moisture, and warmth, these cells multiply with incredible rapidity, at the same time giving off carbon-dioxide and another product. The carbon-dioxide gas collects in bubbles, and thus distends and lightens the dough.

If bread be left in a moist place it will mould. Here, too, we have fungous action.

Moulds, like bacteria and yeast fungi, are ever present and ready to alight and feed upon organic substances suitable to their taste. Roquefort cheese owes its flavor to a certain mould. Another is known to plug up the human ear.

Some of the industries in which the action of the ferment fungi is essential are: The making of buttermilk and cheese, the tanning of leather, tobacco-curing, the fermentation of vegetables (sauerkraut, fodder in silos, etc.), all bread-making where yeast is used, and all fermentation processes in which alcohol is produced.

FUNGI DESTROY WHEAT, TREES, AND WOOD

In 1916 the black-stem rust destroyed in the United States and Canada 280,000,000 bushels of wheat. Add to this a 15 to 25 per cent reduction of the barley and oats crops, and we become aware of the appalling destruction that a single fungous disease can cause.

One of these, *Endothia parasitica,* threatens with extinction the glorious chestnut trees of our eastern coast. The disease caused by this fungus fiend, the chestnut bark disease, starting in the vicinity of New York City about 1904, spread rapidly as far north as New Hampshire and south to Virginia. In its devastating march it has destroyed timber valued at more than two hundred million dollars, and the end is not yet.

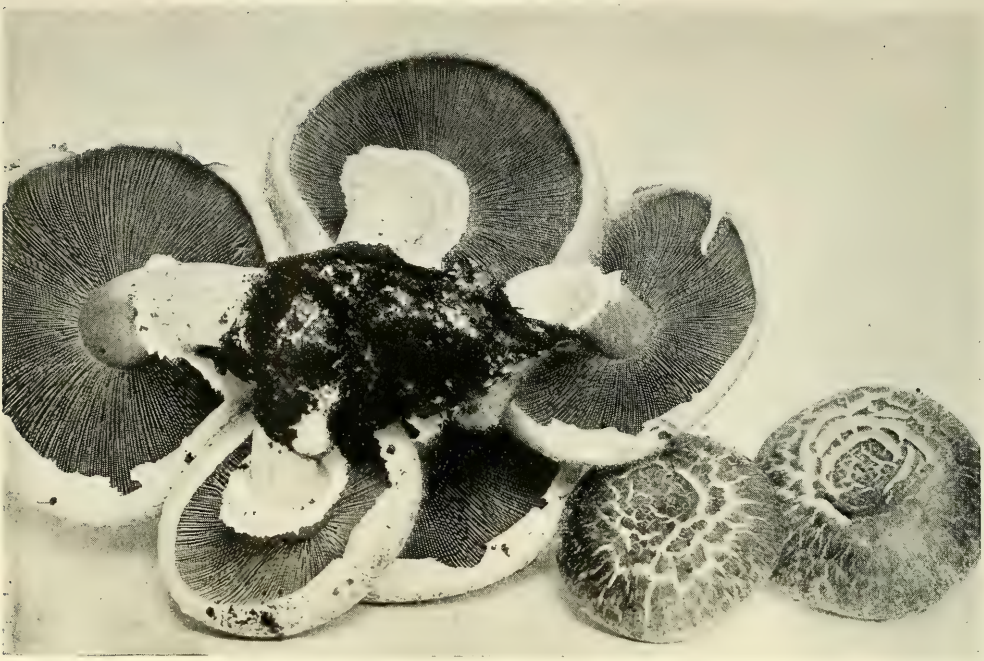
Another disease, the white pine blister rust, though not yet as widely known as the chestnut disease, is likely to become so unless preventive measures are adopted and coöperatively carried out by the States concerned.

While the destruction of living woody tissues is steadily going on in the forests, dead wood, including that used in buildings, railroad ties, etc., is likewise being destroyed by species that specialize in saprophytism or scavenger-work.

ANTS "CULTIVATE" MUSHROOMS

The almost human sagacity of the ant has interested man from earliest times. Isn't it possible that Homer called the Thessalian legions "myrmidons" because they swarmed like ants and fought with the cunning and bravery of these insect warriors? The foresight exhibited by the ant in storing its food, furnished Æsop with the theme for one of his most delightful fables. Later, upon closer observation, we were startled to learn that Mr. Ant is also a good "dairyman,"* milking his "cows" whenever he wants "milk"; but it was not until recently that

* See "Notes About Ants and Their Resemblance to Man," by Dr. William Morton Wheeler, in the NATIONAL GEOGRAPHIC MAGAZINE, August, 1912.



Photographs by A. G. and B. Leeper

THE COMMON MEADOW MUSHROOM (*Agaricus campester*). EDIBLE

Brownish, scaly variety above; white, smooth variety below. Before the war America imported annually millions of pounds of this delicacy from France, and our own producers and bountiful Nature have assisted materially in meeting the ever-increasing demand. Do not attempt to gather this or any other mushroom for eating purposes unless you have a competent authority with you (see Color Plate I and text, page 401). When picked they will fruit again as a continuous crop when cultivated in special mushroom cellars, and out-of-doors as long as the weather is propitious.

Photograph by A. G. and B. Leeper

THE BRICK-RED HYPHOLOMA (*Hypholoma sublateritium*). EDIBILITY DOUBTFUL

Few mushrooms are commoner than the Brick-top. It grows in dense clusters at the base of old chestnut and oak trees. About one-half natural size.

we were apprised of the fact that mushroom-growing is also one of his accomplishments.

Scientific travelers in Java and South America record that some of the larger species, the termites, construct veritable mushroom-cellars, in which they "cultivate" (on the mycelium of some large fungi) little globular bodies as food for themselves.

Mushroom-growing is a most uncertain business unless conditions favorable to the growth of the spawn are rigidly maintained. The ants know this, too, and take precautions necessary to insure a good "crop."

THE COMMON MEADOW MUSHROOM (Agaricus campester)

(*See Color Plate I*)

When the average person uses the word "mushroom" the common Meadow mushroom, or Pink Gill (*Agaricus campester*) is meant (see Color Plate I and photographs on page 400). Imported from France in enormous quantities before the war; cultivated by our own growers with ever-increasing zeal, and gathered in the wild state as soon as it makes its appearance in the fall, it is so well known that even the most timid feel no hesitation in ordering their juicy tenderloin "smothered with mushrooms."

The records, however, show that not infrequently other deleterious species are eaten along with, or in the place of, the common mushroom. It therefore behooves the eater of mushrooms to be as cautious with this species as he would be with one less well known.

Of course, only the most careless or uninformed would mistake the poisonous Amanitas for the Agaricus; but there are other poisonous species, not necessarily deadly, that are apt to get by the eye and into the mouth if one is unaware of, or neglects to observe, the botanical characters that distinguish the good from the bad. Species that are likely to be mistaken for the common mushroom are discussed further on.

Remarks on the preparation of the Meadow mushroom for the table are superfluous, as any cook-book will give full directions.

The common Meadow mushroom is at home in grassy places, lawns, pastures; never in thick woods; also (when cultivated) in cellars, caves, abandoned mines, and in other places where the temperature can be held between 50° and 65° F. and where moisture conditions can be controlled; time, when growing wild, in August and September, occasionally in the spring; when cultivated under suitable conditions, throughout the year; distribution, cosmopolitan.

Photograph by A. G. and B. Leeper

THE OYSTER MUSHROOM (*Pleurotus ostreatus*). EDIBLE

The name of the luscious bivalve was given this species because of a fancied similarity in appearance. The plants may be found from June until late in the Autumn, growing on deciduous trees. About one-third natural size.

If one has discovered one or more trees that bear Pleuroti, it is a good plan to water the spots from which specimens have been taken. In this way the plants may be "cultivated," as new "fruit" will appear in a week or two.

When specimens are brought indoors and placed in a sunny nook, away from drafts, the interesting phenomenon of spore-discharge may be watched. Like twisting, curling spirals of smoke from the burning end of a cigar, the fine spore-rain drifts off into space in quest of tree wounds where it may lodge and start a mycelium that in turn will produce more Pleuroti.

Related species and poisonous species are sometimes eaten in place of it, though *Agaricus campester* is so well marked that it is inconceivable how poisonous species, especially Amanitas, can be eaten by mistake.

A mere glance at the illustrations of the common mushroom and those of the Amanitas (see Plates II, V, X, XV, and XVI) ought to prove instructive, even to the most superficially observing, and, if in addition the descriptions be compared, wide differences will at once become apparent. To call attention to a few: *Agaricus campester* has a squattier appearance; lacks a bag, or volva; has pink gills that turn to a chocolate brown, and never grows in woods or forests, preferring rich, well-manured ground, such as old pastures, where horses are turned loose.

The Amanitas rarely occur anywhere except in woods, or in places where woods have recently stood, such as lawns in new suburbs; throw down from their gills a white spore-powder, and have, in addition to the ring, a more or less pronounced volva at the usually bulbous base of the stem (for figures of the various forms of the Volva, or Death-cup, see Nature's Danger Signals, page 389).

THE FIELD, OR HORSE MUSHROOM (Agaricus arvensis). Edible

(*See Color Plate I*)

This coarse and heavy species is edible only when young and tender. Some epicures object to its anise-like odor. The distinguishing features are: its large size (breadth of cap sometimes more than a foot); peculiar ashy-pink tint of the young gills; large, thick, double ring (the lower one split radiately); the bulbous stem, and the tendency to turn yellow on the slightest bruise.

It is not so choice in its habitats as the common mushroom, growing in cultivated fields, grassy pastures, in waste places, under old hedges, and occasionally near trees, and in the borders of thin woods. It should be sought from July to September. Occasionally it forms huge fairy-rings (see page 397).

THE FLY MUSHROOM (Amanita muscaria and its varieties). Deadly poisonous!

(See Color Plate II for mature plant and Color Plate XV for young specimens)

Beauty, though attractive, is often deceptive. This is admirably illustrated in *Amanita muscaria*, the "most splendid chief of the agaricoid tribe," as Greville, an eminent Scotch botanist, describes it.

"In the highlands of Scotland," he continues, "it is impossible not to admire it, as seen in long perspective, between the trunks of the straight fir trees; and should a sunbeam penetrate through the dark and dense foliage and rest on its vivid surface, an effect is produced by this chief of a humble race which might lower the pride of many a patrician vegetable."

Contrast with this the dire effects of its poisons on the human system. Very shortly after eating the fungi (from one to six hours, depending upon the amount eaten) the victim exhibits excessive salivation, perspiration, flow of tears, nausea, retching, vomiting, and diarrhea. The pulse is irregular and respiration accelerated. Giddiness and confusion of ideas are also present.

Delirium, violent convulsions, and loss of consciousness develop in rapid succession when large quantities have been eaten, the patient sinking into a coma that is followed by death. In light cases the patient, after an attack of vomiting and diarrhea, falls into a deep sleep, from which he awakes several hours later profoundly prostrate, but on the road to recovery. Within two or three days, in such cases, complete recovery takes place.

Atropin is the perfect physiological antidote for muscarin, one of the poisons present. However, being a poison itself, it should not be administered except by a physician. The early appearance of the symptoms is characteristic of poisoning by this species, those caused by *Amanita phalloides* presenting themselves much later (see this species, Plates V, X, and XVI).

The *Amanita muscaria* is very common in woods, thickets, in open places, and sometimes in pastures, from June until the first frosts.

Photograph by George Shiras, 3d

A SPECIES OF PLEUROTUS MUSHROOM GROWING FROM A FALLEN LOG

A sight such as this is calculated to make the mushroom-hunter's mouth water. Note that the central, eccentric, or lateral attachment of the stem to the cap is a matter of position of growth; the caps on the side of the log have lateral stems, those on the top central, or very nearly central, ones (see illustration, page 402).

THE JACK-O'LANTERN MUSHROOM, OR FALSE CHANTRELLE (Clitocybe illudens). Poisonous

(See Color Plate III)

To see light emanating from a mushroom is at least a novel experience that is possible if one views perfectly fresh specimens of the Jack-o'-Lantern by night; but this is the limit of its interest for us. As an edible species, it is not to be thought of; for, though pleasant enough to the taste and enjoyed without inconvenience by some, it acts as a powerful emetic with most people. Moreover, recent chemical investigation of the plant has demonstrated the presence of muscarin in its tissues, the same substance that plays such an important rôle in poisoning by *Amanita muscaria* (see text on this page).

Dense clusters of this Clitocybe may often be seen growing on or about old stumps of chestnuts, oaks, and other deciduous trees. Occasionally, such clusters contain hundreds

Photograph by A. G. and B. Leeper

THE GLISTENING COPRINUS (*Coprinus micaceus*). EDIBLE

Soon after the first showers in April this tiny ink-cap emerges from the ground in clusters of hundreds of individuals. The best harvesting implement is a pair of scissors. It grows at the base of old trees, stumps, and from buried wood in lawns. Caps tawny, and glistening with minute, mica-like particles; stems white. About natural size (see figure, lower left, Color Plate VIII).

of individuals. It should be looked for in the autumn.

The caps often measure as much as ten inches across, the stems being proportionately long.

Pleurotus olearius, another phosphorescent mushroom that parasitizes the olive tree in southern Europe and is also poisonous to human beings, is closely related to, if not identical with, this plant.

EDIBLE AND POISONOUS FLESHY TUBE-FUNGI (Various species of Boletus)

(*See Color Plate IV*)

Though similar in shape, the fleshy tube-fungi differ in one important point from the gill-fungi; instead of gills, the under side of the cap exhibits a layer of small, vertically placed tubes, on the inside of which the spores are borne.

The Boleti are fairly safe; yet the beginner ought to be forewarned against certain species that are likely to cause illness when eaten. Chief among these is a group collectively known as the Luridi. The prime distinguishing mark of species belonging to this group is the more or less bright red, orange-red, or maroon coloring of the tube-mouths; also, all Boleti that show the slightest tendency to assume some shade of blue when broken or bruised should be avoided. Bitter species, too, should not be eaten, especially *B. felleus,* a somewhat robust plant with pinkish flesh-colored tubes.

The edible Boletus, the cèpe of commerce (*Boletus edulis*), Plate IV, is the well known and much sought *cèpe* of the French. Before the war, a regular article of commerce, one could purchase it, either dried or canned, at the little delicatessen shop "around the corner." Now we are dependent upon our own supply, which is none too plentiful. In the coast counties of California, however, it seems to be fairly abundant, for the writer has seen Italian

Photograph by Roland McKee

THE INKY COPRINUS (*Coprinus atramentarius* VARIETY). EDIBLE

This variety lacks the fine scales on the top of the cap, which are prominent in the typical form. The very delicate silvery gray luster of the cap vanishes with the slightest touch. The "ink" from this mushroom makes a forgery-proof writing fluid (see page 439). Natural size.

residents there return from collecting trips with their automobiles laden with them.

In preparing it, either for immediate use or for pickling or canning, the layer of tubes and the tough portion of the stems should be removed. When used fresh, the cooking should be rapid over a brisk fire. Frying or broiling with butter or olive oil, with the usual spices added, seems best adapted for this fungus. When pickled, add cloves, bay leaves, and other spices.

Except for the stem, which is at times much shorter, and club- or pestle-shaped, the illustration shows a fully matured plant. When young, the tubes are pale, creamy white, but as the plant develops they become greenish, and when touched or bruised change to a greenish-ocher color, *not to blue*.

The species is extremely variable, both as to shape and color, some specimens showing a brownish-lilac color on both cap and stem. The constant features, however, are the colors and color changes of the tube layer, and the fine mesh of white lines on the stem, usually but not always confined to the upper part.

The edible Orange-cap Boletus (*Boletus versipellis*) is much coarser and larger than the cèpe and not so desirable. Still, in the absence of something better, it is eaten by those who must have their mushrooms (see page 406).

It is quite common and easily recognized by the numerous rough, blackish points on the stem and by the overlapping margin of the reddish- or orange-colored cap. Its flesh changes color to a neutral, reddish gray.

Photograph by A. G. and B. Leeper

THE ORANGE-CAP BOLETUS (*Boletus versipellis*). EDIBLE (SEE COLOR PLATE IV FOR ANOTHER SPECIES OF BOLETUS)

A large, coarse, tube- instead of gill-bearing plant with a reddish-orange cap, overlapping margin (of the cap), and rough, black-dotted stem (see text, page 405). Compare the under side of the cap with that of the common mushroom (page 400) and other gill-mushrooms included in this article. In the fleshy tube-fungi, instead of gills (see page 390), the under side of the cap exhibits a layer of small, vertically placed tubes, on the inside of which the spores (see pages 392, 405, and 415) are borne.

Photograph by A. G. and B. Leeper

THE EDIBLE BEEF-TONGUE MUSHROOM (*Fistulina hepatica*)

Cap blood-red, pores (on under side of cap) creamy pink, flesh streaked with red and pink, this fungus grows on chestnut and oak stumps from July to October. The plant is so distinct that it is not easily confounded with other species. The illustration is about one-half natural size.

THE HANDSOME VOLVARIA (Volvaria speciosa). Edibility doubtful

(See Color Plate V)

Opinion as to the edible qualities of the Handsome Volvaria diverges considerably. While some speak of it as "a fine edible agaric," others pronounce it "watery and unpleasant to the taste," or even poisonous. Since the plant is somewhat variable, and therefore not clearly separated, except by spore characters, from the very poisonous *Volvaria gloiocephala,* it is advisable to let it alone.

Only recently Prof. W. C. Coker, of the University of North Carolina, reported a variety of *V. speciosa* from the sand dunes of Smith Island, North Carolina. His plant had spores larger than those of the type and differed in other characters.

In the eastern United States it is of infrequent occurrence, but on the Pacific coast, especially in California, it is so abundant during April and May that one finds it wherever the soil is rich with decaying vegetable matter.

The odor of the fresh plant is repellent, resembling very markedly that of rancid lard.

The Handsome Volvaria is gathered from April to October; distribution, temperate North America, Europe, and North Africa.

CORAL MUSHROOMS (Various species of Clavaria). Edible

(See Color Plate V)

"But that is not a mushroom!" exclaims the tyro, seeing his first Clavaria. "Why, it looks like coral."

It is true that these plants show no differentiation into cap, gills, tubes, or teeth, but they are, nevertheless, true fungi, the spores being borne on the exterior of the branches.

With the exception of a single species, all, so far as known, are good to eat, provided the taste is agreeable and the specimens are fresh and free from insect attack. The exception is a species (*C. dichotoma*) in which the branches are rather thin, flaccid, whitish, and divided regularly into twos.

Clavaria fusiformis (see Color Plate V) is long, bright orange-yellow with a delicate bloom, dark-tipped, and usually grows in tufts. The interior is solid at first, then hollow. Occasionally specimens are found that are variously bent, twisted, or malformed.

Clavarias may be sought in both deciduous and coniferous woods from July to September (see illustration, page 412).

Other edible species are *Clavaria flava* and *Clavaria botrytes.*

Photograph by A. G. and B. Leeper

THE EDIBLE *Polyporus frondosus*

Dense masses of this tree fungus may be found growing at the base of oaks and other trees. The color of the upper surface of the caps is a sooty-gray; that of the lower, finely porous side, white. The illustration is about one-third natural size.

Photograph by George Shiras, 3d

A BRACKET-FUNGUS (*Polyporus applanatus*)

Note the concentric zones marked with match-sticks. Each zone indicates the limit of a year's growth. The under side of this woody fungus makes an admirable sketching surface. A sharp twig will do for a pencil. The bracket fungus is the fruit-body of a destructive parasite very common in our forests (see page 417). You do not rid the infected tree of its fungus parasite by removing the fruit-bodies. The disease is produced by the mycelium (or spawn) threads, which (more or less compacted into tissues) permeate the wood of the tree. This particular species has a whitish, porous surface, which is easily embrowned on the slightest touch—hence its use as a sketching surface.

THE DEADLY AMANITA, OR DESTROYING ANGEL (Amanita phalloides and its varieties). Deadly poisonous!

(*See Color Plates V, X, and XVI*)

"Do not eat mushrooms and you will not be killed by them."

If every one followed this injunction, further advice would be superfluous. That it is not universally followed is certain, for each year brings new records of poisoning cases, most of which are caused by species of Amanita. The first duty of those who insist on eating mushrooms is, therefore, to become thoroughly familiar with the botanical features of this genus. These once impressed upon the mind, the danger from Amanita poisoning will be much reduced if not entirely eliminated.

The following characterization of Amanitas should be memorized by the beginner as he would memorize a theorem in geometry:

Any white-spored, more or less free-gilled fungus that possesses both ring and volva is a member of the very dangerous genus Amanita (see chart, page 389).

Extremely common in all parts of the country from June until the first frosts, the deadly Amanita grows singly or scattered, in and near both deciduous and coniferous woods, in the soil, among leaves, particularly where the ground is low, wet, and not too sandy; also in places where woods have recently been cut down, such as lawns, pastures, and fields in new suburbs.

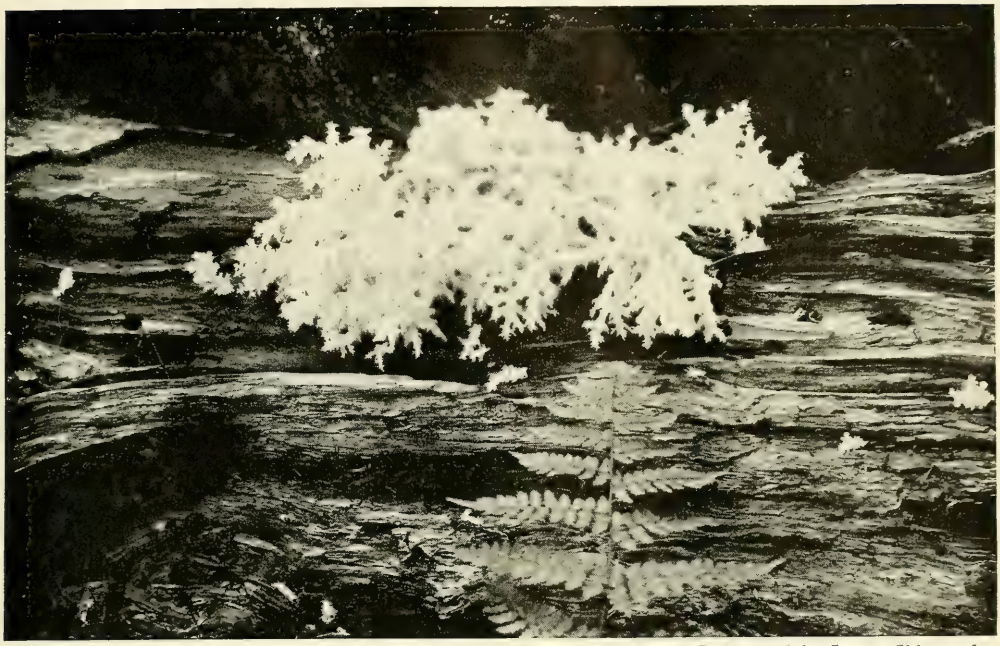
The symptoms of poisoning from this fungus appear much later than those due to *Amanita muscaria*. The unfortunate victim remains quite well until seized suddenly with violent abdominal pain, in from six to fifteen hours after eating the fungi. Excessive vomiting, thirst, and either diarrhea or constipation accompany the abdominal pain.

The paroxysms of pain may be so severe that the face becomes drawn, pinched, and of a livid color (Hippocratic face). The attacks of pain and vomiting come on periodically, the patient loses strength rapidly, jaundice frequently sets in, and coma finally develops, fol-

Courtesy of Dr. George T. Moore, Director of the Missouri Botanical Garden, St. Louis, Mo.

THIS EXQUISITE CORAL HYDNUM (*Hydnum coralloides*) IS EDIBLE

It is said that the illustrious Swedish botanist, Elias Fries, was attracted to the study of fungi on beholding a specimen of this species growing in a forest of his homeland. Size: Individual clumps up to 10 inches.



Photograph by George Shiras, 3d

AN UNUSUALLY BEAUTIFUL CORAL MUSHROOM (*Hydnum laciniatum*) GROWING ON A PROSTRATE TREE

The species is closely related to *H. coralloides,* shown on page 410. It is edible when white and fresh. Size: Individual clumps up to 10 inches.

lowed by death. Convulsions may or may not occur toward the end.

The duration of the illness is from three to eight days, depending upon the age of the patient and upon the amount of fungus eaten. There is no known antidote for the poisons, and the death-rate is, therefore, very high, ranging from 60 to 100 per cent.

A description of *Amanita phalloides* and its varieties: Cap 2 to 6 inches broad, fleshy, at first egg-shaped to bell-shaped, then obtusely convex, finally plane or depressed (concave when old and overexpanded), usually a little elevated in the center, but not umbonate, white (in the spring form, *A. verna,* and in *A. virosa,* the latter illustrated in Plate X), light yellowish-white, dull yellow or light brown, grayish, grayish-brown or olive-brown (livid purplish-brown in *A. porphyria*), the disk frequently darker in some individuals, approaching black (see Plate XVI), citron-yellow (*A. citrina,* illustrated by the figure on the extreme right in Plate V), greenish yellow, green or olive-green, occasionally streaked with darker shades of the prevailing color or with dull reds.

THE HONEY-COLORED MUSHROOM, OR OAK FUNGUS (Armillaria mellea). Edible

(*Upper figure, Color Plate VI*)

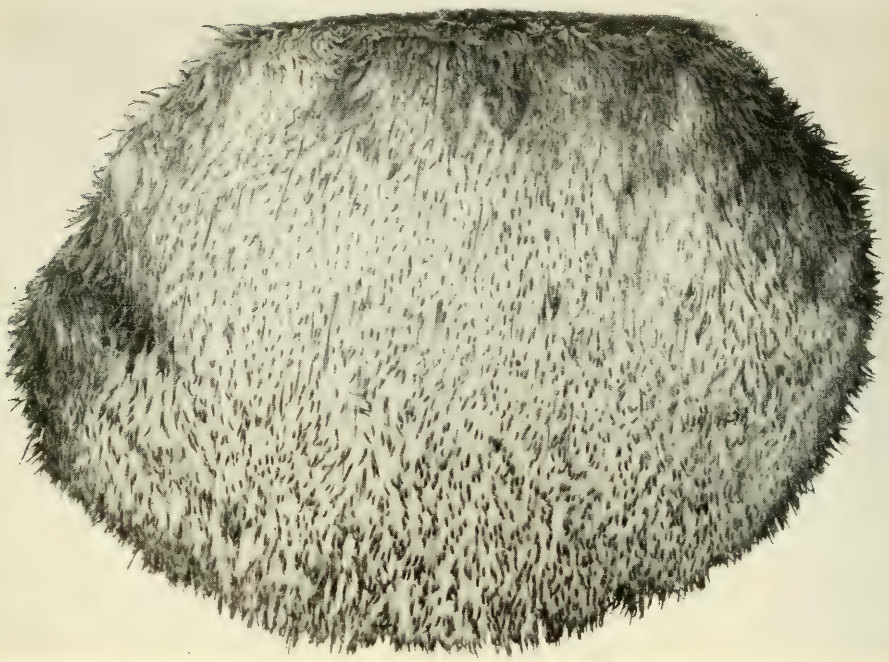
Tête de Méduse is a French common name for this agaric, the appearance of which in an orchard is as much feared by the owner of the trees as was the Gorgon head of old.

Its appetite for living, ligneous substance is truly astounding. With equal zest it feeds upon oaks, chestnuts, pines, larches, hemlocks, and white cedars, reserving for dessert the grapevine and most fruit trees. When times are hard and "pickins' slim," it turns upon the humble potato. Once, so far as we know, its attack was met, and this by an orchid. After a battle for supremacy, the two finally came to an understanding and decided to work together for their mutual benefit.

Like most successful organisms, it has a great capacity for adapting itself. Equally at home on plains, mountain peaks, and in mines, it pursues its prey relentlessly, its rapid propagation being aided by blackish cords (rhizomorphs) that do reconnoitering duty under the ground and under the bark of trees. Even the orchardist plowing over the site of a tree killed by the Armillaria unwittingly assists in its distribution by scattering fragments of these rhizomorphs over new feeding ground.

Much work has been done to combat this fungus pest, latest among which is that by Prof. W. T. Horne, of the University of California.

As might be expected in so widely distributed and adaptable a plant, its tendency to vary, both in color and in structure, is almost limitless (see pages 394 and 395).



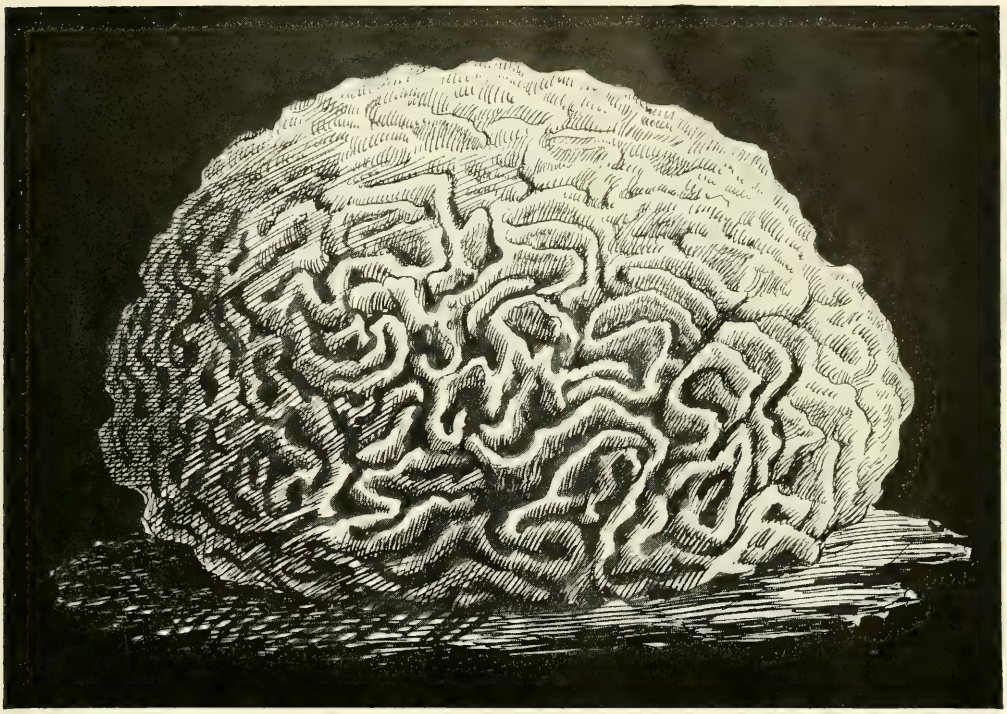
THE HEDGEHOG HYDNUM (*Hydnum erinaceus*). EDIBLE

Not infrequently the assiduous mushroom-hunter, "new to the game," finds specimens that do not tally with his conception of what a mushroom should be like. This is one of those surprises. Whitish to creamy-white when fresh. Somewhat under natural size.

Photographs by A. G. and B. Leeper

A CORAL MUSHROOM (*Clavaria flava*). EDIBLE

The novice seeing this remarkable growth for the first time finds it difficult to believe that it is a mushroom. Branches pale yellow; base and main stems white. Common in woods from July to September. Somewhat under natural size. (For another Clavaria, see Color Plate V, middle figure.)



A HUGE, CONSPICUOUS MUSHROOM SOMETIMES FOUND IN FORESTS (*Sparassis herbstii*). EDIBLE

This rare and beautiful fungus should be looked for in oak woods. About one-half natural size.

Because of the acrid taste that is usually present in the raw plant, it is not rated very high as an edible species.

This mushroom grows wherever there is wood to be attacked in the open, commonly in woods, on the ground, or on decaying stumps and trunks of trees, singly, scattered, or in dense clusters; time, mainly in the autumn, though it may occur as early as June; distribution, cosmopolitan.

THE GARLIC MUSHROOM (Marasmius scorodonius). Edible

(*See Color Plate VI*)

Some people enjoy the flavor of garlic. To these it will be interesting news that they may have their garlic in mushroom form if they will enter a pine or spruce forest. Here, in vast hordes, covering the fallen twigs, sticks, and needles, grows the little Marasmius. One cannot mistake the plant, for the odor is so pronounced that the "nose knows" it before the eye sees it.

It may be used like garlic, in dressings, and as a flavor for roasts, etc. Since it occurs in great abundance and dries readily, it can be stored for use in the winter, when it will also prove a reminder of the pleasant days spent in mushroom-hunting. The dried plants must be steeped in water before they are employed in the kitchen.

The Garlic mushroom grows in woods, especially of pines, on needles, twigs, etc.; time, July to October, very plentiful after heavy rains; distribution, temperate North America and Europe; also in Siberia.

THE LITTLE WHEEL MUSHROOM (Marasmius rotula). Edible

(*See Color Plate VI*)

After a summer shower it pays to scrutinize closely the decaying débris of a near-by wood. Almost certainly one will see on bark, roots, and old leaves tufts of this delicate and marvelously made little agaric.

Note particularly the manner in which the hair-like stem is set into the tiny socket, the sparsity of the gill development, and the fine furrows and scallopings of the margin of the cap. A Swiss watchmaker could not excel such workmanship.

During dry weather the plants shrivel into invisibility, but, like all members of the genus Marasmius, they regain their pristine freshness with the return of rain. Sometimes, as if fatigued from the production of so much minute workmanship, the plants fail to produce caps, and the stems, too, are often abnormally grown together in a branching manner.

For culinary purposes this species is used as an addition to gravies. When garnishing veni-

Photograph by A. G. and B. Leeper

THE GEMMED PUFF-BALL (*Lycoperdon gemmatum*) FOUND EVERYWHERE

Though small, this "gem-studded" species is much sought by mushroom-eaters and may be discovered growing scattered or in tufts, usually on the ground. About one-half natural size.

son, it adds the appropriate touch of the wild woodlands.

This species grows on decaying wood (bark, roots, and stumps) and on old leaves in woods of maple, beech, etc.; time, June to September; distribution, temperate North America, Europe, and South Africa.

HEDGEHOG MUSHROOMS (Various species of Hydnum)

(*See Color Plate VI*)

Not infrequently the assiduous mushroom-hunter, "new to the game," finds specimens that do not tally at all with his conception of what a mushroom should be like. He has soon learned, of course, to recognize the gill tribes (see page 390), and the Boleti (see page 406), and perhaps the Clavarias (see page 412), but should he encounter a toadstool with "teeth," he will be nonplussed, until assured by his mycological mentor that there are such "animals," and that they go by the name of Hedgehog mushrooms.

They are not as frequent as the others, and therefore all the more of a surprise when met with. Some are conspicuously beautiful, and the story that the great Swedish mycologist, Elias Fries, was attracted to the study of the fungi on beholding in his youth a specimen of the snowy-white coral Hydnum may well be believed (see illustration, page 410).

The teeth, varying in size and color in different species, clothe the lower side of the fruit-bodies, which may be cap-like, as in agarics and boleti, branched, solidly formed into tuberous, fleshy masses, or spread out in a flat layer. No poisonous species are known, though many are tough, bitter, or malodorous, and thus naturally unattractive to the mycophagist.

Hydnum fennicum, the Finnish Hydnum (see Color Plate VI), is too bitter to be eaten, but its general aspect gives some idea of the appearance of the edible *H. imbricatum*. The latter species has a more umber-colored, less reddish cap, no blue discoloration in the flesh of the stem, a less bitterish taste, and coarser teeth. Deer are said to be fond of it.

THE CINNAMON CORTINARIUS (Cortinarius cinnamomeus). Edible

(*See Color Plate VII*)

Plants belonging to the bulky genus *Cortinarius* are very numerous in our forests during the autumn months; yet, except for a few well-characterized species, one and all are left severely alone by the average student of mushrooms; this not because of any fear from poisoning—the genus is a fairly safe one—but because of the difficulties attending their study.

It is easy enough to say that one has found a "Cort"—the term of endearment for members of this "offish" genus. To determine the plant

Photograph by A. G. and B. Leeper

THE GIANT PUFF-BALL (*Calvatia gigantea*)

The best-known of all puff-balls. A single specimen will suffice for the largest family. Diameter often fourteen inches and over.

As children, we have all squeezed the puff-ball to make it "puff," little realizing that in doing this we were liberating billions of spores, which—if everything went well with them—would produce in turn billions of puff-balls. But there is "many a slip" in the life of a puff-ball spore. Were this not so, the whole country at the proper season, would be paved with puff-balls.

A recent investigator, Professor Buller, computing the number of spores in a single good-sized specimen of the giant puff-ball, found that it contained about seven trillions (7,000,000,000,000); and yet this species is by no means as common as those who know its delicious flavor would like it to be. One is inclined to ask—as we do about the fate of pins—what becomes of them all? . . . The plant grows in grassy places, in August and September, sometimes in "fairy-rings." It is not very common, we regret to say.

To escape acceptance of the theory of the spontaneous generation of life, it has been suggested that extraordinarily minute organisms (bacteria, for example), or their spores, propelled alive through space, might be capable of carrying life to planets. When it is considered that the vitality of some spores remains unimpaired after prolonged exposure to liquid air and even liquid hydrogen, the suggestion seems plausible.

See also pages 392 and 402.

Photograph by A. G. and B. Leeper

THE CUP-SHAPED PUFF-BALL (*Calvatia cyathiformis*) COMMON IN FIELDS

The purplish-brown surface, cracked like an alligator's skin, is the distinguishing feature of this much-hunted species, which grows in pastures and in cultivated lands during August and September. Less than one-half natural size.

specifically, however, is a different problem, largely for the reason that it is essential to have more than one specimen, preferably a whole series, covering the development from extreme youth to full maturity.

If such a series is at one's disposal, important notes can be made—first, on the difference in the gill-color of young and old specimens; second, on the color of the cobweb-like veil, present in all true Cortinarii, and on the presence or absence of a secondary or universal veil; third, on the shape, color, and general surface characters (including degree of stickiness) of the plants.

The species included here and figured in its natural colors is sometimes found. The change in the color of the gills is shown, as is also the difference in the general aspect due to growth. The amateur would scarcely consider the two plants as belonging to one species. To complicate the situation further, this species has several varieties, one of which, with blood-red gills, is quite common.

Many species of *Cortinarius* exhibit beautiful coloration, the light lavender, blue, and violet-colored ones being noted in this respect. A few have bright red bands encircling their stems, as in the common *C. armillatus*.

THE CHANTRELLE (Cantharellus cibarius). Edible

(*See Color Plate VII*)

On special state occasions the golden Chantrelle graces the festive board, yet there is no reason in the world why it should not be on every man's table throughout the land and throughout the year. Abundant and easily recognized, any one may gather it in quantity and without fear of being poisoned.

Its natural habitat is in forests of spruce, pine, hemlock, beech, and other trees; commonly found growing in troops, from June to October. Long cooking over a slow fire, in a covered vessel, improves both flavor and consistency. The dressing may be simple or very elaborate. It dries readily.

Though a somewhat variable fungus, both as to shape and color, its characteristic, dull-edged, irregularly forked gills render identification easy.

It is a cosmopolitan species, but limited, as are most fleshy fungi, to the more temperate regions of the earth (see *Clitocybe illudens*, the False Chantrelle, Plate III).

THE PERENNIAL POLYSTICTUS (Polystictus perennis)

(*See Color Plate VII*)

When in the woods, "stalking" the edible fungi, the hunter, sensitive to the beautiful as well as the useful, cannot but stop to admire the little cinnamon-colored cups of various Polystictus species that stud his pathway. The present species is one of the commonest. A West African species, the magnificent *Polystictus sacer* is an object of religious worship with the natives. Let us hope that it is merely a worship at the shrine of beauty.

The genus *Polystictus* is a member of a large family, the Polyporaceæ. Some of the bracket- or hoof-shaped species of the polypores are familiar objects to the forest rambler. Unfortunately, they are only too familiar to the forester, many being very destructive to our trees. *Polyporus applanatus,* a common bracket fungus, deserves notice because of the use to which it is put by the collector who combines artistic proclivities with his mycologic ones. The under, or hymenial, surface of this fungus is almost white. Upon the slightest scratch, however, the white is removed and a dark line appears.

Provided with nothing more than a good fresh specimen of this fungus and a stylus in the form of a sharp-pointed branchlet, conveniently picked up at his feet, the artist-mycologist may proceed to sketch the landscape. If he has the ability of a Seymour Hayden or a Pennell, the result will compare favorably with a good etching. After the fungus is thoroughly dry, the picture is permanently fixed, and it may then be set up in the summer bungalow to recall a day pleasantly and profitably spent (see page 409 for illustration of *P. applanatus*).

THE EQUESTRIAN TRICHOLOMA (Tricholoma equestre). Edible

(*Lower left figure, Color Plate VII*)

The Tricholomata are attractive agarics. Clean, trim, often of elegant stature and beautiful coloring, they have become known in some countries under the attractive name of Knightly mushrooms. The time for their appearance is rather late in the autumn, when the air is a little chill and the forest foliage is beginning to glow with Titian's tints.

The present species, the Equestrian tricholoma, is one of the better-known examples of the genus. It is edible and therefore eagerly sought as soon as the weather is propitious. The taste is apt to be a little unpleasant in uncooked plants, but this is true of a number of edible species, notably of *Armillaria mellea* (Plate VI) and of *Lactarius piperatus,* a very large, coarse, white, "milk"-exuding species, common in woods. Conversely, some of the deadliest species of Amanita give no forewarning at all through the sense of taste.

The Equestrian tricholoma is found in pine woods; time, September to November; distribution, North America and Europe.

MORELS. (Edible)

(*See Color Plate VII*)

The Morel, or Sponge mushroom, belongs with the Ascomycetes, fungi quite distinct from those which bear gills, tubes, teeth, etc. Not only is there a marked departure in the external form, but the microscopic features, likewise, show a fundamental difference (see pages 420-421).

The normal time for Morels to appear is in spring, though they have been known to occur in autumn. After a gentle April shower, the fungus-hunter, betaking himself to the nearest apple or peach orchard, or to recently burnt-over wooded areas, searches for the light brownish, fawn-colored, or olive gray, pitted heads. If luck is with him he doesn't search long, for he soon finds enough of the coveted "sponges" to give him his first taste of fresh mushrooms of the year.

For centuries the Morels have been favorites with the fungus-epicures. Indeed, so highly were they regarded by some European peoples that forests were burned down by them to obtain the substratum best suited to their development—a method of procedure that recalls Ho-ti's way of roasting pigs. In recent years efforts have been made by French investigators to grow the plants artificially.

Before proceeding to cook them, the plants should be washed to remove any earth that may be lodged in the pits of the cap. Then, cutting off as little of the stems as possible, the hollow interior must be thoroughly rinsed with hot water. Having further assured one's self that the plants are perfectly fresh, crisp, and clean, cooking can begin.

The methods of preparation for the table are various. Stuffed with veal, chicken, or anchovies, and garnished as elaborately as one pleases, they are especially delicious. But they lend themselves to any mode of cooking. Pennsylvania farmers, who know them as "Merkels," prefer them in a pot-pie.

Different species have been distinguished, but they are one and all edible when in first-class condition. Some, like *M. esculenta* (Color Plate VII), have a more or less rounded cap; others are conical in shape (*M. conica,* page 420), and one, which is said to be better than the rest, has a somewhat oblong, cylindrical, olive-gray cap, which is often a little curved (*M. deliciosa,* page 420). The species *M. semilibera* is shown in the illustration on page 421.

THE DELICIOUS, OR ORANGE-MILK, LACTAR (Lactarius deliciosus). Edible

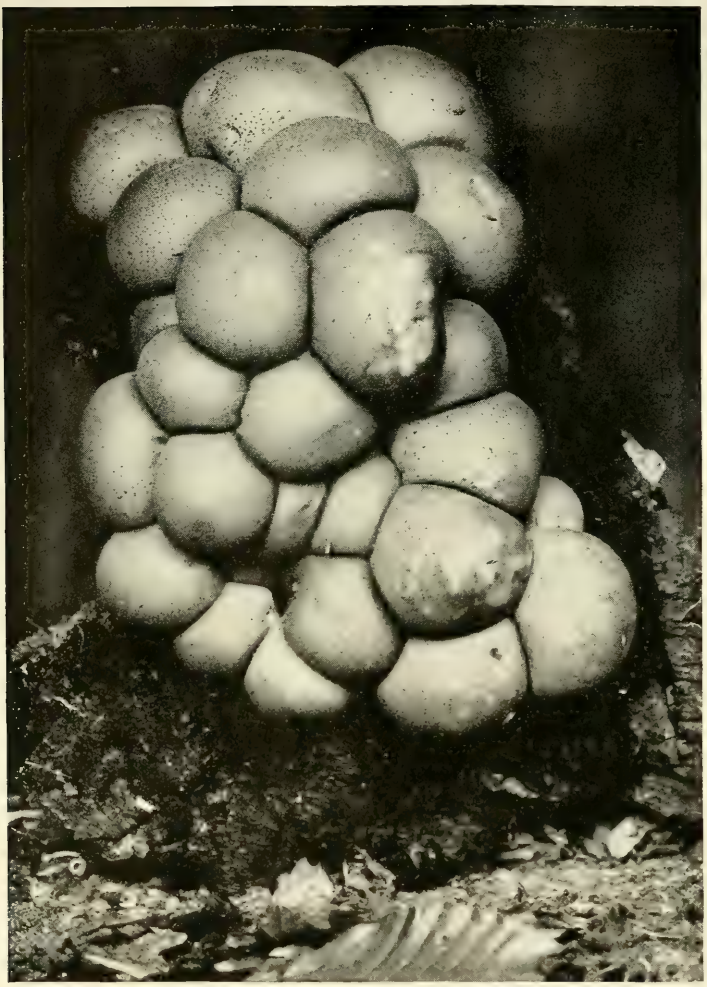
(*See Color Plate VII*)

When injured, certain fungi have the peculiarity of exuding a colored, uncolored, or color-changing juice, called "milk," or latex. Among the larger gill-fungi that have this property are the members of the genus Lactarius.

Of the numerous edible species, the Orange-Milk Lactar—so named because of its orange-colored milk—is the most generally known, its reputation extending back to the old herbalists of the sixteenth century, and possibly to ancient Roman days, for a picture of this species, said to be the earliest representation of a fungus extant, was discovered on a wall in ill-fated Pompeii.

The following quotations will convey some idea of the esteem in which it was and is still held.

Sowerby says: "It is very luscious eating, full of rich gravy, with a little of the flavour of mussels." Sir James Smith pronounces it "the most delicious mushroom known." Other



Photograph by A. G. and B. Leeper

THE PEAR-SHAPED PUFF-BALL (*Lycoperdon piriforme*)

This small, edible species may be found on almost any rotting stump or log from July to late in the autumn. Natural size or a little under (see also picture on opposite page).

commendatory comments are: "Good, preserved in vinegar" (Richon and Rozé); "Most excellent" (Berkeley); "Fried with butter and salt, it has a taste like lamb" (De Seynes).

Dr. Peck, our own more recent authority, says, it is "one of our most valuable mushrooms, but scarcely equal to the best. Doubtless differences of opinion concerning it may be due in part to different methods in cooking."

With regard to tastes, it is always well to remember that they are individual; "otherwise moths would not eat cloth."

When eaten in the raw state, the Orange-Milk Lactar develops an acrid taste, and when old its bright-orange coloring changes to dull, grayish-greenish, unattractive hues. It is, therefore, inadvisable to eat uncooked or old specimens. Pickled in vinegar, however, it is very appetizing when served as a relish with cold meats.

This desirable species is found in moist, mossy woods of pine, tamarack, hemlock, etc.; time, July to October; distribution, North America and Europe.

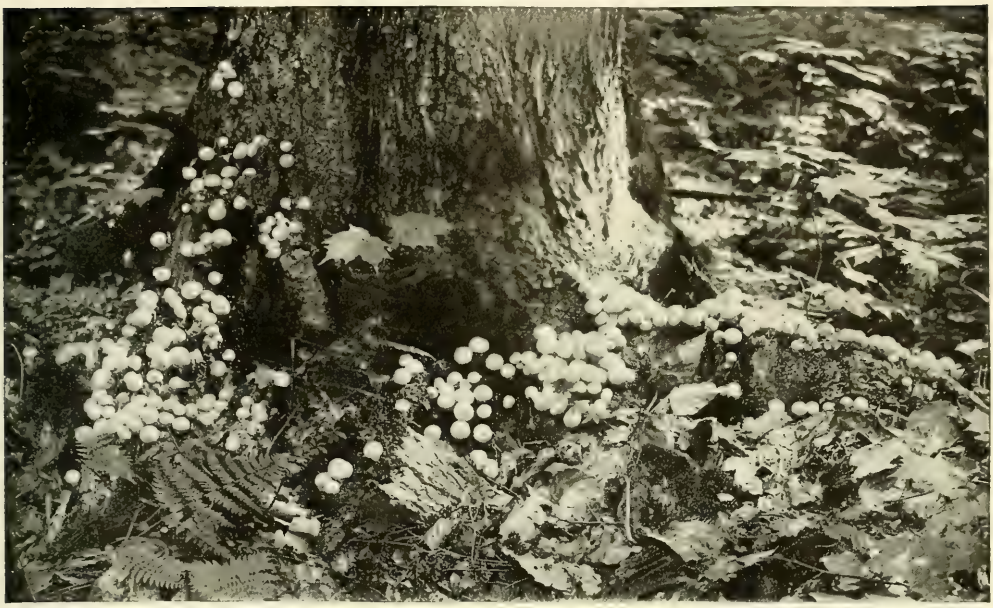
PANÆOLUS Species
Poisonous

(*See Color Plate VIII*)

Every collector of edible species should learn to distinguish the Panæoli from *Agaricus campester* and the Coprini. Because of the dark, blackish coloring of their gills, they are very apt to get into a mess of either of these species, and when this happens the eater is almost sure to experience symptoms of poisoning. The differentiation of the species is an extremely difficult matter, but, generically, they are easily recognized by their slender stems, grayish or reddish-brown (sometimes hygrophanous), commonly bell-shaped or obtusely expanded caps, and—most important—by the black, or very nearly black, spores that are borne on non-deliquescent gills, generally in spot-like areas, causing the gills to appear mottled with black.

The symptoms from Panæolus poisoning appear very soon after the fungi have been eaten, sometimes within fifteen minutes. They seem to vary slightly, depending, presumably, upon the species and the amount consumed. The following have been recorded: failure of muscular coördination, giddiness, difficulty in standing, inability to walk, drowsiness, lack of control of the emotions (inordinate hilarity), incoherent or inappropriate speech. The sight is usually affected, causing the furniture to appear bent, pliable, and in motion; and there are visions of beautiful colors. Temporary paralysis of a limb may occur.

The effects of the intoxication are said to pass off within a few hours; still, it would seem that emetics ought to be administered without delay to prevent the complete absorption of the poisons.



Photograph by George Shiras, 3d

THE PEAR-SHAPED PUFF-BALL (*Lycoperdon piriforme*)

It is seen growing on and about the base of a tree (for another illustration of this species, see page 418). The plants are edible as long as the "flesh" is white.

Photograph by A. G. and B. Leeper

THE SKULL- OR BRAIN-SHAPED PUFF-BALL (*Calvatia craniiformis*)

One of the best, so long as the interior is white. Once the color changes, it is very bitter. Should be looked for in the autumn, in thickets by roadsides. About one-third natural size.

Photographs by A. G. and B. Leeper

MORELS: UPPER FIGURE, *Morchella deliciosa;* LOWER FIGURE, *Morchella conica.* EDIBLE

After a gentle April shower the fungus-hunter will find these delectable mushroom morsels growing in old apple and peach orchards or in recently burnt-over wooded areas. The plants vary in height from two to six inches (see figure, lower right, Color Plate VII, and text, page 417).

THE BROWN GYROMITRA (*Gyromitra brunnea*). EDIBILITY DOUBTFUL

Since one species of Gyromitra is known to be poisonous, it is perhaps just as well to let them all alone. *G. brunnea* reaches a height of seven inches.

Photographs by A. G. and B. Leeper

THE HALF-FREE MORCHELLA (*Morchella semi-libera*). EDIBLE

This morel is small and not as sapid as the larger species. The term "half-free" refers to the attachment of the cap to the stem. The sectional view on the extreme right shows that the cap is only half-attached, or half-free. (For other Morels, see page 420 and figure in lower right, Color Plate, VII.)

LAWN MUSHROOMS (including **Naucoria semiorbicularis,** edibility doubtful, and **Pholiota præcox,** edible)

(*See Color Plate VIII*)

Some one has said that he who wishes to explore the world should begin at his own doorstep. Addressed to the incipient mushroom collector, this maxim imparts wholesome advice, for without stirring far from home—yes, within eyeshot of his front door—he can collect enough species to make a respectable list, and not a few that will give him something more substantial in the way of a delicious snack of mushrooms; also, he is likely to encounter some that are poisonous.

Among the species to be looked for on lawns and other grassy places are:

Naucoria semiorbicularis (see Color Plate VIII, the small cluster and single figure in upper right), is very common on lawns. The caps are somewhat sticky in wet weather and the stems have a characteristic, easily removed, pale pith within. Edibility doubtful.

Pholiota præcox, the early Pholiota (see Color Plate VIII, showing two plants, young and old, lower right). This is another common, edible, mushroom of our lawns. Appears early in the spring. The young plant shows the ring before it becomes detached from the edge of the cap; the older one shows this tissue hanging down and covered with a dense deposit of the rusty-brown spores. The cap of the early Pholiota varies in color from darkish ocher and brownish to a creamy white more or less pale. Occasionally the surface is finely cracked into little areas. The variety shown here grows in thin woods. In young plants the gills are colored a beautiful warm gray.

THE GLISTENING COPRINUS (Coprinus micaceus)

(*See Color Plate VIII*)

The Glistening Coprinus (*Coprinus micaceus*), illustrated on page 404, is familiar to every one. It is one of the first mushrooms to respond to the showers of early spring. Almost any stump will yield hundreds of specimens. To save trouble, the abundant crop should be "harvested" with a pair of shears. When simmered down they make an excellent ketchup.

The minute glistening particles on the cap and the fine, long grooves on the margin of the same at once mark the species.

THE IMPERIAL AGARIC, OR CÆSAR'S MUSHROOM (Amanita cæsarea). Edible

(*See Color Plate IX*)

This brilliantly colored, stately agaric is the famed "boletus" served at the feasts of the emperors of ancient Rome, and lauded in prose and verse by the writers of that period. So highly was it esteemed by epicures that they prepared and cooked the plants themselves, performing these operations with utensils of amber and gold. Special vessels, "boletaria," were used in cooking the boleti, though in some households they doubtless got mixed occasionally with other pots and pans. Martial, in his "Epigrams," lets one that was so treated bewail its fate:

> "Although boleti have given me
> so noble a name, I am now
> used, I am ashamed to say, for
> Brussels sprouts."

From Juvenal we learn that the preparing of boleti by the young patricians themselves was regarded as a sign of the mollycoddle, for he writes:

> "Nor will that youth allow any
> relative to hope better of him
> who has learnt to peel truffles
> and to pickle boleti."

Cæsar's mushroom grows with us today, its distribution being limited, however, to the States east of Ohio. It is especially abundant in the South, and occurs sparingly as far north as Nova Scotia. If there is much showery weather, it may be looked for in open coniferous and deciduous woods from July to October. Occasionally it forms huge "fairy-rings."

Except for the very real danger of confounding it with the deadly *Amanita muscaria* (Color Plates II and XV, and chart, page 389), there is no reason why it should not again become a favorite with those who, like the old Romans, are fond of rare delicacies. But those who wish to try it should postpone the pleasure until they are thoroughly familiar with a considerable number of Amanitas, as an error in observation may mean death, preceded by horrible agonies (see the symptoms of poisoning by *Amanita muscaria,* on page 403).

No difficulty will be experienced in avoiding the citron-colored variety of the deadly *Amanita phalloides* (see figure at extreme right of Plate V). The cap in that variety is never orange, the gills and stem are never clear yellow, and the volva is composed of short, thick segments surrounding the upper part of the large, globular base of the stem.

[For Color Plate X, see the Deadly Amanita, page 409).

THE SOOTY LACTAR (Lactarius lignotus). Edibility doubtful

(*See Color Plate XI*)

To the city dweller, who through force of circumstances is allowed a limited number of cubic feet of air in which he must "live, move, and have his being," it must be tantalizing to read that this attractive lactar leads its life in the cool, mossy depths of the vast fir forests. In the hot months of July and August, the time of its occurrence, it is well to have ready this excuse for an outing: "I am going in quest of the sooty lactar."

THE FIELD, OR HORSE MUSHROOM (*AGARICUS ARVENSIS*): Edible
The large plant and sectional view. Somewhat reduced in size.
The strong, sweetish odor given off by this agaric is objectionable to some.
THE COMMON MEADOW-MUSHROOM (*AGARICUS CAMPESTER*): Edible
Figure at lower right. Under natural size.
When the average person says "mushroom," it is this species that is meant.

THE FLY-MUSHROOM (*AMANITA MUSCARIA*): Deadly poisonous
Mature specimen. Somewhat under natural size.
This species and *Amanita phalloides* (see Nos. X and XVI) are the common causes of serious mushroom-poisoning (for figures of young plants, see No. XV).

JACK-O'-LANTERN (*CLITOCYBE ILLUDENS*): Poisonous
About four-fifths natural size.

A conspicuous object by daylight, this Clitocybe is also visible in the profoundest darkness, the phosphorescent light which it emits betraying its presence. Should not be confounded with the edible Chantrelle (see No VII, figure at upper right).

THE EDIBLE BOLETUS, THE "CÈPE" OF COMMERCE (*BOLETUS EDULIS*)
Somewhat under natural size.
The mushroom connoisseur should cultivate the acquaintance of this most excellent species.

Figure on left: THE HANDSOME VOLVARIA (*VOLVARIA SPECIOSA*). Edibility doubtful. In the genus Volvaria there is a volva, but no ring; the spores and gills are pink or reddish, and the latter are free from the stem. Middle figure: CLAVARIA FUSIFORMIS. Like tongues of flame, this beautiful Clavaria shoots from the mossy beds of cool, moist woodlands. It is edible. Figure on right: THE LEMON-YELLOW AMANITA (*AMANITA CITRINA*). Deadly poisonous. Some mycologists consider this a variety of *Amanita phalloides* (see Nos. X and XVI).

Upper figure: THE HONEY MUSHROOM, OR OAK FUNGUS (*ARMILLARIA MELLEA*): Edible. This common agaric is the bane of the orchardist (see also photographs and text). Figure in the middle on the left: THE GARLIC MUSHROOM (*MARASMIUS SCORODONIUS*): Edible. The odor of garlic is so pronounced in this little species that the "nose knows" it before the eye sees it. Figure in the middle on the right: THE LITTLE WHEEL MUSHROOM (*MARASMIUS ROTULA*): Edible. When garnishing venison, this dainty Marasmius adds the appropriate touch of the wild woodlands. Lower figure: THE FINNISH HYDNUM (*HYDNUM FENNICUM*). This species is too bitter to be eaten, but the nearly related *H. imbricatum* is a great favorite with European peoples All figures about two-thirds natural size.

Upper left: THE CINNAMON CORTINARIUS (*CORTINARIUS CINNAMOMEUS*). The Cinnamon Cortinarius is not highly recommended as an edible species. Upper right: THE CHANTRELLE (*CANTHARELLUS CIBARIUS*): Edible. (See *Clitocybe illudens*, No. iii.) Upper middle: THE PERENNIAL POLYSTICTUS (*POLYSTICTUS PERENNIS*). "Stalking" fungi, the hunter, sensitive to beauty as well as usefulness, must stop to admire this species. Lower left: THE EQUESTRIAN TRICHOLOMA (*TRICHOLOMA EQUESTRE*): Edible. They appear in our forests late in autumn. Lower right: THE MOREL (*MORCHELLA ESCULENTA*): Edible. Esteemed by epicures. Lower middle: THE DELICIOUS, OR ORANGE-MILK LACTAR (*LACTARIUS DELICIOSUS*): Edible. "It is very luscious eating, full of rich gravy, with a little of the flavour of mussels." All figures about two-thirds natural size.

Upper left: A species of PANÆOLUS (poisonous). Upper right: NAUCORIA SEMI-ORBICULARIS (edible qualities doubtful). Lower left: THE GLISTENING COPRINUS (*COPRINUS MICACEUS*): Edible. Lower right: THE EARLY PHOLIOTA (*PHOLIOTA PRÆCOX*): Edible. All figures about two-thirds natural size.

CÆSAR'S MUSHROOM (*AMANITA CÆSAREA*): Edible
Somewhat under natural size.

History tells us that a dish of this mushroom, "seasoned" with mineral poisons, constituted the last meal of the Roman Emperor, Claudius Cæsar. His wife, Agrippina, did the seasoning.

THE DESTROYING ANGEL (*AMANITA PHALLOIDES* VAR. *VIROSA*).
Deadly poisonous. About four-fifths natural size.
One of the worst of the man-killing mushrooms. Note the "death-cup" at the base of the stem (see No. XVI; and No. V, figure on right).

THE SOOTY LACTAR (*LACTARIUS LIGNIOTUS*): Edibility doubtful
Somewhat under natural size.
The play of light on the velvety coat of this species attracts the artist who delights in texture rendering.

THE SHAGGY-MANE (*COPRINUS COMATUS*): Edible
About four-fifths natural size.

The oval caps of the Shaggy-mane, poised on end, like Columbus' egg, are familiar objects on lawns and other rich grounds. Note the "cord" suspended in the hollow of the stem.

THE GYPSY (*PHOLIOTA CAPERATA*): Edible
Somewhat under natural size.

Though commonly known as *Pholiota caperata*, this species has been so much thrown about, from genus to genus, that, like the gypsies, it may be said to be quite homeless; whether this is the reason for its common name has not been ascertained.

THE PARASOL MUSHROOM (*LEPIOTA PROCERA*): Edible
About four-fifths natural size.

The Parasol is a prime favorite with mushroom eaters—so much so, that one shares a mess of it only with one's best friend.

THE FLY-MUSHROOM (*AMANITA MUSCARIA*): Deadly poisonous
Young specimens. Natural size.
A mature specimen is shown in No. II.

THE DEADLY AMANITA (*AMANITA PHALLOIDES*)
Somewhat under natural size.

The avoidance of *Amanita Phalloides* and *A. muscaria* (see No. II) should be the first concern of the mycophagist.

Fully to appreciate its beauty, one should see the plant in Nature's own setting, as it reposes upon a fresh, green, mossy bank at the foot of a great fir, with the crystalline drops of the morning dew still studding the smooth, velvety coat, with birds singing overhead and squirrels scolding us for calling at such an unseasonable hour in the morning.

THE INK MUSHROOMS, OR INK-CAPS (Species of Coprinus)

(See Color Plate XII)

The Ink-caps need no formal introduction, for every one has seen the "Shaggy-mane" (Coprinus comatus) (Color Plate XII) standing on end, like Columbus' egg, in lawns and other grassy places. If one returns later one may behold

"Their mass rotted off them flake by flake,
Till the thick stalk stuck like a murderer's stake,
Where rags of loose flesh yet tremble on high,
Infecting the winds that wander by."

Shelley's lurid lines allude to the liquefaction of the caps, a feature which at once distinguishes the Coprini from other black-spored agarics. It is, however, not a process of putrefaction, as the poet would have us believe, but a natural physiological one.

Shaggy-manes are rapid growers, and, coming up in dense masses, as they sometimes do, they are capable of producing considerable pressure upon objects that obstruct their growth. The writer knows of a case where a thick, newly laid concrete walk was broken up for some distance by a colony of these large, yet tender, mushrooms.

The black "ink" into which the caps of Coprini dissolve can be employed for writing. Indeed, in France, during the war, it was proposed that Coprinus ink be used in place of the regular article, which was becoming more and more expensive. But even in peace times the mushroom ink would prove valuable, as it could be used in legal documents or in any important papers that are apt to be fraudulently imitated.

Ink from some especially rare species with well-marked spore characters would be well-nigh impossible to imitate, as the microscope would divulge instantly and beyond peradventure whether the fluid was obtained from the rare Coprinus. To make matters still more difficult for forgers, characteristic, easily recognized spores from other rare species—not necessarily black-spored nor from agarics—could be added to this forgery-proof and indelible writing fluid. Small amounts of gum arabic and essence of cloves in the ink will give adhesiveness and a pleasant odor.

The edibility of the Coprini (see also Glistening Coprinus, Color Plate VIII) is unquestioned by most writers, but care should be exercised that only fresh specimens are utilized, and that they be cooked without delay, as deliquescence sets in very soon.

THE WRINKLED PHOLIOTA, OR THE GYPSY (Pholiota caperata). Edible

(See Color Plate XIII)

The ocher-colored cap with whitish, fleecy, silky fibrils scattered over the central portion, the brownish-yellow, longitudinally wrinkled, saw-edged gills, together with the slightly volvate, whitish stem that bears a double-edged ring about midway of its length, make the Wrinkled Pholiota one of the most easily recognized species.

It is quite common, growing scattered or gregariously in woods (especially of pine), in mossy swamps, and in open places, from July to October. Its edibility is unquestioned.

THE PARASOL MUSHROOM (Lepiota procera). Edible

(See Color Plate XIV)

Happy is the mushroom-hunter if, after a foray, his "bag" includes many Parasols, for it is not often that he encounters this most desirable species in sufficient quantity to satisfy his appetite.

Though pretty effectually camouflaged in coloring, its great height makes it a conspicuous object. A giant specimen once reported to the writer measured seven inches across the cap and twenty-two inches in stem length. This monster mushroom was found growing among low blueberry bushes—a fact that would seem to indicate an acid food requirement for the species.

Successful efforts have been made in France to cultivate the plant from its spores, and Professor Duggar, in this country, has demonstrated that it responds vigorously to the tissue-culture method. It is to be hoped that some of our pure-culture spawn-producers will take up the problem and produce the spawn on a commercial scale, so that it may be bought by growers. *Lepiota rhacodes,* a near relative and just as desirable, might prove even more responsive to culture methods.

In the opinion of gourmets, the Parasol mushroom is at its best when quickly broiled over the live embers of a camp-fire, with just enough basting with hot butter to keep it from burning. Then, properly seasoned and served with a partridge or two, the gustatory apparatus experiences sensations not readily forgotten.

Such an eventuality as an oversupply almost never happens, but if by rare chance more specimens should be collected than can be at once disposed of, it is well to remember that dry they are even better than fresh.

The habitat of the Parasol mushroom is meadows, pastures, and open, thin woods; time, summer and early autumn; distribution, cosmopolitan.

[For Color Plate XV, see the Fly Mushroom, page 403.]
[For Color Plate XVI, see the Deadly Amanita, page 409.]

HURDLE RACING IN CANOES

A Thrilling and Spectacular Sport Among the Maoris of New Zealand

By Walter Burke

THE title of this article sounds like a fairy tale; yet hurdle racing in canoes is a highly developed sport among the New Zealand Maoris.

Two or three things are necessary for the sport: First, the canoes must be dug-outs. The dainty canoes so popular on the American lakes and rivers and the beautiful birch-barks of the Canadian voyageurs would be too fragile, crumpling up like matchwood at the first hurdle.

A swift-running river is also desirable, in order that the crews may have the help of the increased speed given by the current to carry the centers of the canoes over the hurdle. This is an important consideration, as can be seen from the photographs. And the contestants must be good swimmers. As every Maori—man, woman, or child—is, there is no risk of drowning, even in the roughest water.

One sees the game at its very best at Ngaruawahia, a village in the North Island, a little south of Auckland, on the seventeenth of March in any year—St. Patrick's Day.

At this point the Waikato, one of the finest rivers in the Dominion, widens out and sweeps round a bend to meet another branch. The river carries a great volume of water, draining an enormous watershed in the center of the island, including Lake Taupo, into which some thirty streams discharge. The Waikato plunges over the Huka Falls, a miniature Niagara, below which are the Aratiatia Rapids, quite impassable for any boat. It is at this point that it is proposed to generate sufficient electricity to run the railway system of the North Island.

Prior to *the* day, the Maoris collect from all the adjacent territory, bringing with them their prize canoes, each dug out of the trunk of a tree. Some of these boats are large enough to carry a crew of from thirty to more than forty paddlers. These are not for hurdling, however!

The secret—more or less—trials proceed; training is keen and hard; the betting heavy, for most Maoris are well-to-do and are keen sportsmen, willing to gamble on anything, from "fly loo" to a horse-race! The excitement progresses till the eventful day, when special trains bring immense numbers of Maoris and Pakehas (white people) from far and near.

The program includes many and varied events, but the great attraction is the hurdle racing, just as the steeplechase attracts the eager crowd at a turf event. Of course, in saying this, I am not belittling the excitement over the big canoe races. There is not the fun in these, however, as there are no accidents, while the hurdle racing is one continuous series of them—a spill at practically each hurdle, of which there are usually three or four.

Unless the bow of the canoe is well out of the water, it cannot take the hurdle, which is from twelve to eighteen inches above the surface. The object is to get up such speed that when the bow slides on to the hurdle the smooth and well-greased bottom will continue to glide till past the center of gravity, when the members of the crew run forward and their weight causes the bow to go down with a "flop" and the stern slides off. The bow usually dips under and partly fills the canoe with water, which is removed by rocking or is splashed out with the aid of the flat of the paddle.

This is the program when all goes well! And it will probably happen when one canoe can shoot away from the others and negotiate the first hurdle alone. But usually about four or five canoes come down almost simultaneously, the crews yelling like fiends, and there is a thrilling mix up, from which the brainiest crew, with the best of luck, gets out of the ruck and away.

© Walter Burke

MAORI WOMEN ARE SKILLFUL PARTICIPANTS IN THESE CONTESTS: THIS IS A RACE FOR MATRONS

One boat has upset. The Maori women, like the men, are expert swimmers and a spill in the water is not fraught with danger.

© Walter Burke

NINETY PADDLES CHURNING THE WATER

Note the uniformity of stroke and the level keels. The use of a hollowed log as a canoe makes skill a necessity. The principal races among the Maoris of New Zealand take place on St. Patrick's Day.

© Walter Burke

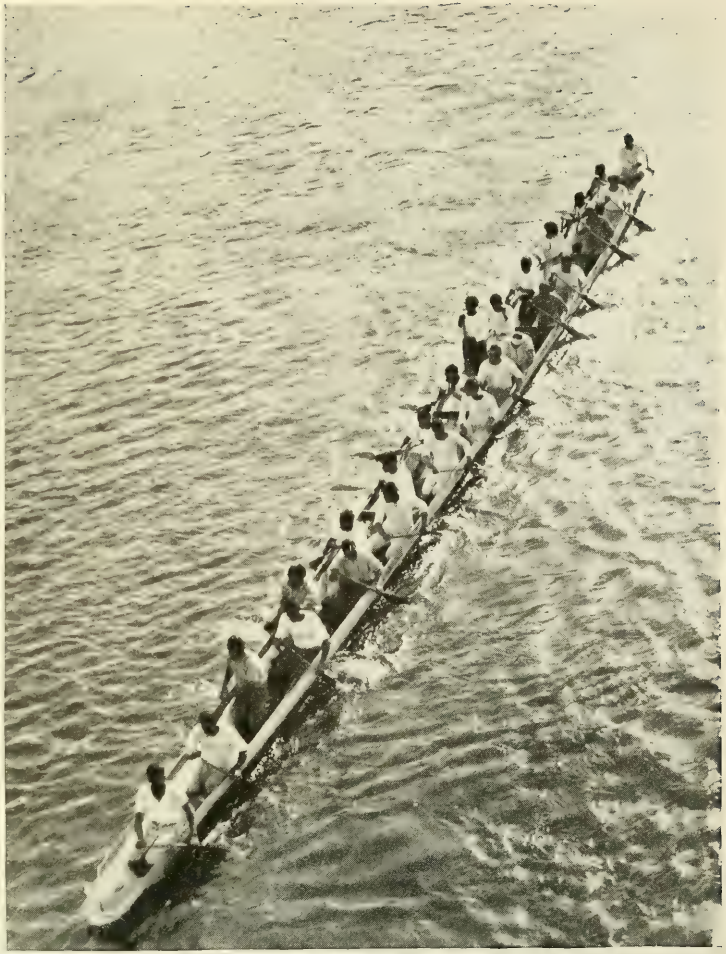
HURDLE RACING IN CANOES: A MARINE VERSION OF "OVER THE TOP"

Boat-racing, hurdling, and the good old game of teeter-board are combined in this contest. One of the boats is rising to the hurdle, the weight having been shifted to the stern. Another is debating whether to tip forward or back, and the favorite is over and off with a splash. No lumberjack in a log-jam ever had more thrills.

© Walter Burke

A THIRTY-MAN-POWER DUGOUT MAORI CANOE

When thirty persons set out to break paddling records in a single log, it is well to ask whether they can swim. Every Maori can. The sides of the log are sometimes heightened by planking, but a promenade deck above the "engine-room" is an improvement still undeveloped.



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WHEN CHEERS BECOME JEERS

These overturned hurdle-racing contestants are literally "in it up to their necks." The fine lines of the Maori dugout can here be seen to advantage.

HIAWATHA USED THE BARK; MAORIS USE THE TRUNK

The leader stands in the middle of the boat. Many of these strong-limbed young Maoris won fame or death as "Anzacs" in the World War.

MALTA: THE HALTING PLACE OF NATIONS

First Account of Remarkable Prehistoric Tombs and Temples Recently Unearthed on the Island

By William Arthur Griffiths

Original photographs by courtesy of R. Ellis and Lieutenant Tickle

MALTA is but a tiny island, less than a hundred square miles in area, with no special beauty of hill or dale, almost without tree or stream, yet by the inscrutable decree of Destiny it has been called to fill a great rôle in the history of the world.

Situated in the narrowest part of the Mediterranean, it lies in the direct route from Gibraltar to Port Said or the Dardanelles, midway from Italy to its turbulent colony of Tripoli and from the French territory of Tunis to their watch-tower at Corfu, at the mouth of the Adriatic (see map, page 449).

Nature has thus ordained that Malta, by reason of its position, should form a center from which naval activity in this sea can be controlled.

"Some are born great . . . and some have greatness thrust upon them." It is to the latter class that Malta belongs.

Since the outbreak of the World War, Malta has resembled the Tower of Babel after the confusion of tongues. In its harbors transport after transport has anchored, each crowded with troops of varied race—English, Scot, Irish, Welsh, Australian, New Zealander, French, Italian, Portuguese, Russian, Japanese marine, Serbian, Montenegrin, Greek, Cretan, Hindu, Bengali, Gurkha, Pathan, men from Ceylon and the Straits, Maori, Chinese, Annamite, Tonquinese, Egyptian, Moor, Arab, Tunisian, Congolese, Senegalese, Zouave and Chasseur d'Afric, gay Bersaglieri—in seemingly unending procession.

Here also came, as prisoners, Austrians, Bulgars, Turks, and Germans, some from the famous *Emden*.

Malta was indeed a Haven of Refuge, and all too soon they passed onward, some to find a watery grave, many more to die by murderous poison gas, by fiery burning oil, or by more merciful shot and shell.

Soon Malta became the Island of Hospitals, where the sick and maimed, the fever-stricken and blind, found such rest and comfort as this world can give. Ere long this privilege was denied, as the enemy submarine spared neither hospital nor passenger ship, woman nor child.

"A PLACE OF CURSED STEPS"

Malta has thus been the halting place of many nations, and one wonders what thought or message it has given to them. "A place of cursed steps," was Byron's unpoetic tribute. "Bells, yells, and smells" is the terse but graphic description of the British bluejacket, while to the majority of visitors it is merely a treeless waste of arid stone, almost incandescent in the blinding glare of the summer sun.

In each of these descriptive phrases there is much truth; yet to those who peer below the surface Malta is one of the treasure-houses of the world, where the history of mankind can be read in lasting tables of stone.

Untold ages ago coral insects laid the early foundations of Malta, their work being afterward submerged to a great depth. Memorials of the latter period are found in the beautifully enameled teeth, about six inches long, of sharks now extinct, identical with those dredged up in the deepest part of the Pacific Ocean by the *Challenger* deep-sea expedition.

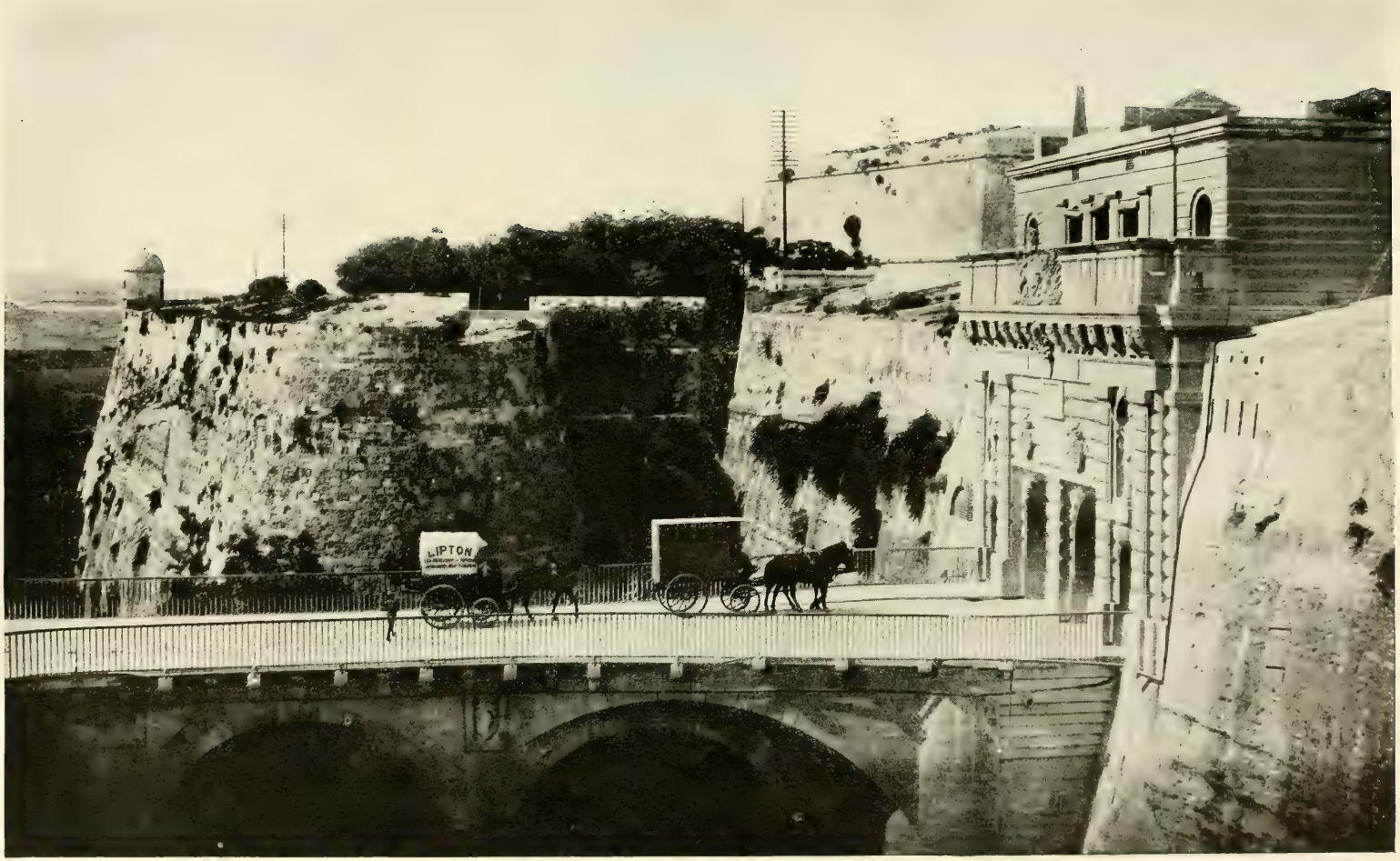
Slowly the land rose again, receiving the soil and debris from the fresh-water river of some continent now unknown. Thus were formed the marl beds to which Malta owes her means of maintaining life, as without this layer of clay the rain would sink and be lost. Next came a layer of sand, and again the coral insect brought the land to the surface of the

A VIEW OF THE WATER FRONT AT VALLETTA, SHOWING A PART OF THE BRITISH MEDITERRANEAN FLEET AT ANCHOR

Photographs by S. L. Cassar

GRAND HARBOR AND THE BRITISH SALUTING BATTERY IN THE FOREGROUND: MALTA

Malta has been a British possession for more than a hundred years. Valletta, its capital, is one of the most important ports of call in the world and is the base and resort for repair and refitment of the British fleet in the Mediterranean. The entrance of the harbor is to the left. A steamer can be seen departing through the narrows.



Photograph by S. L. Cassar

THE GATE TO VALLETTA, SHOWING THE OLD WALLS OF THE CITY AND THE MOAT

Valletta takes its name from its founder, Jean de la Vallette, who was Grand Master of the Order of the Knights of Malta during the famous siege of the island in 1565, when the forces of Sultan Suleiman the Magnificent, under Dragut, were defeated. The defenders numbered between 6,000 and 9,000, while the assailants were variously estimated at from 29,000 to 38,500. Grand Master Vallette had previously participated in the defense of Rhodes, had been captured by Dragut and made to row as a galley slave until ransomed (see page 453).

Photograph by Helene Philippe

THE FORTIFICATIONS OF VALLETTA ARE PARTLY HEWN IN THE ROCK

Enthroned above its harbors, the chief seaport of the Maltese group of islands is one of the most picturesque cities of the Mediterranean.

sea. Many changes occurred, until Malta emerged as part of a mighty continent.

Dimly is seen Africa joined to Spain, Tunis, Sicily, Malta, and Italy, their shores washed by fresh-water lakes in which disported elephant, hippopotamus, crocodile, and land tortoise, until the floods descended and the earth was moved, turning the lakes into salt seas and forming the island of Malta.

PREHISTORIC MEN OF MALTA LEFT THEIR MARK IN CART RUTS

In the caves of Malta, notably that of Ghar Dalam, are to be found the rolled fossil teeth and bones of the great and pigmy elephant, two species of hippo, petrified remains of stag, bear, and wolf, all welded into a solid mass.

As the vertical section of these deposits is examined, there appears toward the top the first signs of man-worked flints, sling-stones, neolithic pottery, and human bones. Thus is found the first trace of man in Malta.

Whether "Drift Man" was ever an inhabitant of Malta is a moot point for academic discussion. In a hilltop excavation, the underground galleries of Hal Saflieni, the ceilings of some of the rooms are covered with red clay paintings of spiral design suggesting a connection with the period of the painted caves of the Pyrenees (see also page 471). It is

A SKETCH MAP OF MALTA, A TINY ISLAND WHICH HAS PLAYED A GREAT RÔLE IN WORLD HISTORY (SEE PAGES 450-454)

established beyond doubt, however, that Malta was inhabited by man before it assumed its present shape.

In many parts of the island where the bare rock is exposed there can be seen deep parallel lines—cart ruts—winding their way quite irrespective of the present centers of abode. Some of the cart ruts lead direct to the cliffs, while others can be traced under an arm of the sea, coming up again on the opposite shore. In other cases the tracks are broken by a geological fault, the ruts continuing on a different level. Many ruts are now covered by several feet of earth, fields having been formed on their sites (see page 455).

In later Stone Age times Malta possessed a considerable population, judging from the wonderful buildings erected in those days. Some have been investigated, but the majority are still untouched.

Beside the magnificent temple of Gigantia in Gozo, Malta possesses the unrivaled erections of Hagar Kim (page 457), Mnaidra (page 459), Corradino, Hal Saflieni Hypogeum (page 459), and Hal Tarxien (page 469), as well as numerous rough stone monuments and altars technically known as menhirs and dolmens.

The extent of some of the prehistoric buildings and the wonderful skill displayed in their erection show that man had reached a high state of knowledge even in the far-off days of B. C. 5000.

From an examination of the skeletons of the polished-stone age, it appears that the early inhabitants of Malta were a race of long-skulled people of lower medium height, akin to the early people of Egypt, who spread westward along the north coast of Africa, whence some went to Malta and Sicily and others to Sardinia and Spain.

There appears little doubt but that the early Maltese belonged to the same stock as the Iberians of Spain, the Basques of the Pyrenees, the Gauls of France, and the small, dark men of Cornwall, South Wales, and Ireland.*

THE ARRIVAL OF THE PHŒNICIANS

The Bronze Age dwellers in Malta left behind many interesting relics, a burial place having been found on the site of the Stone Age temple of Hal Tarxien, whose ruined walls doubtless provided good shelter for their funeral fires. Numerous urns containing human ashes were found, together with many personal ornaments, the whole providing a very good insight into their belief that the departed were not dead, but merely removed into another sphere, where they required the same food and other necessaries as in this life.

History proper starts in Malta with

* See "The Races of Europe," by Edwin A. Grosvenor, in the NATIONAL GEOGRAPHIC MAGAZINE for December, 1918.

Photograph by S. L. Cassar

MANY OF THE THOROUGHFARES OF VALLETTA, MALTA'S PRINCIPAL CITY, CONSIST OF FLIGHTS OF STAIRS. THIS IS THE STRADA SANTA LUCIA

Perched high upon a peninsula a mile and a half long and a half mile wide, Valletta looks down on the Grand Harbor on the east and on the Marsamuscetto Harbor to the west.

the visits of the Phœnician traders, about B. C. 1500. On the Gigantia at Gozo is an inscription in Phœnician lettering, the usual script in the Mediterranean until the advent of Greek or Latin characters.

The ships of Tarshish found Malta a valuable port of call, and in this fact lay Malta's fate. In common with all islands, its whole prosperity has depended on the good-will of the ruling sea power, from the days of Tyre to the very present hour. Greeks, Carthaginians, Romans, Vandals, Arabs, Normans, Spaniards, Turks—all in succession held power in Malta by reason of their fleets.

It is doubtful if the Punic domination affected the characteristics of the Maltese race, as this was probably only a ruling and trading caste, few in number. It is likely that during this time or in early Roman days the custom of burial in hillside caves was adopted. Thousands of these tomb caves exist. In them is generally found an urn full of broken human bones, with a flat plate placed over the mouth and a clay lamp on the plate. Bottles of food and water were also placed in the tomb. Beautiful glass vessels of iridescent blue, purple, and green are also frequently found in these graves.

The capital of Malta was situated far from the coast—about six miles—on the highest land, the present Notabile. Here, outside the city walls, were excavated the catacombs which extend to a considerable distance. The fact that the sign of the seven-branch candlestick is carved over some of the entrances would suggest a Jewish ownership, but this is open to doubt, as the Jews have rarely thrived in Malta.

WHERE ST. PAUL WAS SHIPWRECKED

At Notabile was the seat of the Roman governor. His residence has been recently excavated and many interesting relics found. In A. D. 60 St. Paul was shipwrecked in the bay now known by

his name, and in the Acts of the Apostles is this account of his stay in the island:

"And when they were escaped, then they knew that the island was called Melita.

"And the barbarous people shewed us no little kindness: for they kindled a fire, and received us every one, because of the present rain, and because of the cold.

"And when Paul had gathered a bundle of sticks, and laid *them* on the fire, there came a viper out of the heat, and fastened on his hand.

"And when the barbarians saw the *venomous* beast hang on his hand, they said among themselves, No doubt this man is a murderer, whom, though he hath escaped the sea, yet vengeance suffereth not to live.

"And he shook off the beast into the fire, and felt no harm.

"Howbeit they looked when he should have swollen, or fallen down dead suddenly: but after they had looked a great while, and saw no harm come to him, they changed their minds, and said that he was a god.

"In the same quarters were possessions of the chief man of the island, whose name was Publius; who received us, and lodged us three days courteously.

"And it came to pass, that the father of Publius lay sick of a fever and of a bloody flux: to whom Paul entered in, and prayed, and laid his hands on him, and healed him.

"So when this was done, others also, which had diseases in the island, came, and were healed:

"Who also honoured us with many honours; and when we departed, they laded *us* with such things as were necessary.

"And after three months we departed in a ship of Alexandria." . . .

St. Paulo and St. Publio are very prominent names in the ecclesiastical history of the island, and to this day the activities of St. Paul in Malta are recited in great detail.

After the fall of Rome Malta became

Photograph by A. W. Cutler

A FAMILIAR NAME IN A FOREIGN PORT

"The First and Last Lodging House" may be seen at Valletta, Malta, the name suggesting those inns and road-houses on the outskirts of American cities which formerly intimated by the name "First and Last Chance" that liquid refreshment might be had inside.

FISHING IN THE HARBOR: VALLETTA, MALTA

Malta is only 60 miles from Sicily, 140 miles from the mainland of Italy, and 180 miles from Africa. The cool evening breeze which comes from snow-capped Mount Etna is one of the delightful climatic features of the island.

Photographs by S. L. Cassar

A FISHERMEN'S LANDING PLACE AT VALLETTA

The Maltese are famous throughout the Mediterranean as fishermen, merchants, and mariners. According to a recent census, the fishing industry employed about 3,000 persons operating 900 boats.

subject to various powers, until finally the Arabs, who also ruled Sicily, took possession. While excavating the Roman governor's villa at Notabile several Arab graves were found, all pointing eastward. Their Semitic inscriptions seemed strangely out of place in a Roman ruin. The Arabs built the fortress of St. Angelo, which guards the entrance to the Grand Harbor, on a site formerly occupied by a Roman temple dedicated to Juno.

In A. D. 1090 Count Roger of Normandy, having conquered Sicily, landed at Malta and exacted tribute from the Arabs. An inscribed stone over the entrance to Fort St. Angelo records the Norman victory, and several beautiful Norman buildings are still to be seen at Notabile.

The Arabs finally left Malta about A. D. 1250, having exercised rule over the island for nearly 400 years, doubtless facilitated by their language, which is closely akin to Maltese.

During the next three centuries Malta did not figure largely in history. It lacked agricultural resources and was periodically ravaged by the commanders of Turkish fleets, who dragged the unfortunate inhabitants into slavery, while famine and plague often followed in their wake.

In 1530 the population of the island did not exceed 25,000 and was probably considerably less.

THE BIRTH OF THE ORDER OF ST. JOHN

In that year a great change occurred. Charles V of Spain granted the islands of Malta and Gozo, together with the town of Tripoli, in Africa, to the Order of St. John of Jerusalem, afterward known as the Knights of Malta.

In the early 11th century a pilgrimage to the holy places at Jerusalem was a very arduous and dangerous undertaking and many pilgrims died from exhaustion. A hospital was founded about 1085 at Jerusalem for the use of pilgrims and was dedicated to St. John. To meet various requirements, the hospital was reorganized and an Order instituted, consisting of ecclesiastics, to administer to the spiritual wants of the pilgrims, lay brothers for secular duty, and knights for defense and protection.

After the capture of Jerusalem by the Saracens, Crusaders from all kingdoms of Christendom hastened eastward and the Knights of St. John, then installed at Acre, added members of many nationalities to their number. In 1252 the Pope granted the title of Grand Master to the head of the Knights.

For general convenience, the Order was divided into subdivisions according to the principal languages spoken by its members. The sections of the Order were the "Langues" of Provence, Auvergne, France, Italy, Aragon, Catalonia, Navarre, England, Germany, Castile, Leon, and Portugal. The Langue d'Angleterre was dissolved in 1540, at the Reformation. An Anglo-Bavarian Langue was reinstituted in the 18th century.

Each Langue had its own headquarters, or "Auberge," and those built at Malta are monuments of architectural beauty. They are now used chiefly as government offices and during the World War were scenes of intense activity.

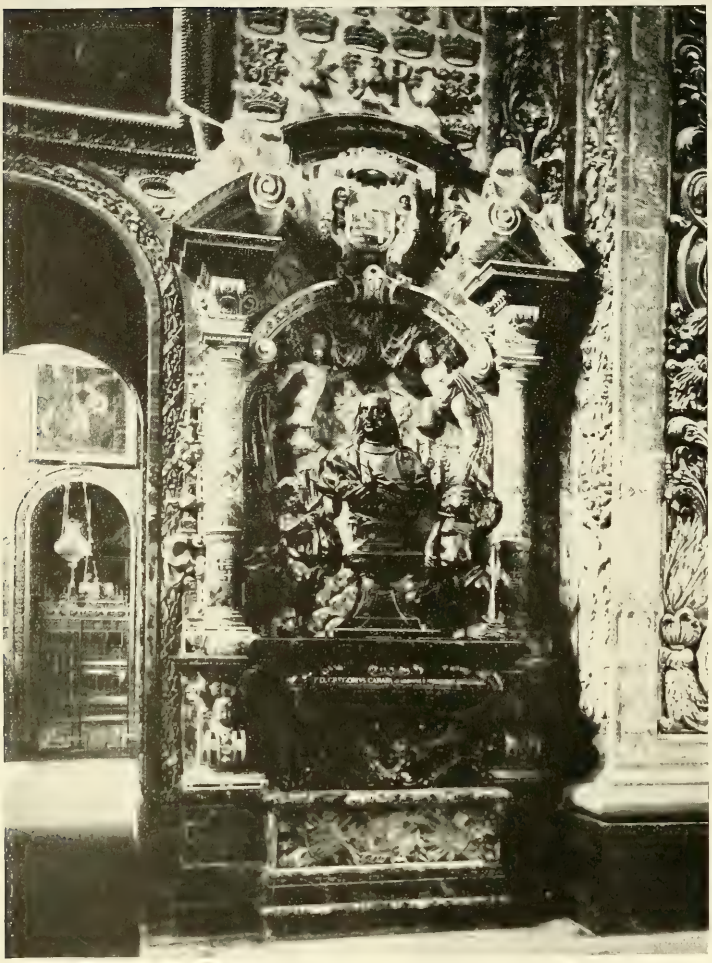
THE TURKS DEFEATED BY LA VALLETTE

The Order removed from Acre to Cyprus and thence to Rhodes, where its headquarters remained until the island's fall, in 1522.* The old bond between Rhodes and Malta was commemorated by the Pope, who gave the Bishop of Malta the title of Archbishop of Rhodes.

In 1565 the Turkish fleets made a powerful attack on Malta, but were finally defeated by Grand Master La Vallette, who built the city of Valletta in memory of the victory. The Cathedral of St. John, in Valletta, was also built as a burial place for the Grand Masters, the remains of those previously interred in the Chapel of Fort St. Angelo being transferred.

In the latter part of the 18th century the Langue de France was the richest and most powerful section of the Order. Lack of military enterprise and luxurious living, however, sapped the power and prestige of the Knights, who were cordially hated by the Maltese. The French Revolution at one blow deprived this

* See "Historic Islands and Shores of the Ægean Sea," by Ernest Lloyd Harris, in the NATIONAL GEOGRAPHIC MAGAZINE, Sept., 1915.



Photograph by W. A. Griffiths

TOMB OF GRAND MASTER CARAFA IN ST. JOHN'S CHURCH, VALLETTA: MALTA

This cathedral was built in 1573-77. The interior was elaborately decorated as the Temple of Fame for the Order of the Knights of St. John. The chapels were dedicated to the nine nations of the order (see page 453).

Langue of most of its revenue, and a similar fate soon befell the other sections.

In the course of the next few years the Order sank and for a time dwindled into oblivion. The Order still exists in England and works in conjunction with the St. John's Ambulance Society and British Red Cross Society, all of which rendered magnificent service during the World War.

In 1798 the wheel of Fate again brought Malta into prominence. Napoleon, profiting by the temporary absence of the British fleet from the Mediterranean, seized the island on his way to Egypt. He expelled all members of the Order, confiscating their property and also that of the Church.

It is related that the solid silver gates of the Sacramental Chapel of the Cathedral of St. John were hastily painted over, in the hope of escaping notice, but in vain. They were, however, redeemed at a great price, together with the twelve silver statues of the Apostles.

HOW THE HISTORIC CROZIER WAS SAVED

The historic crozier that had been brought from Rhodes escaped the enemy by being thrown into a cistern by the verger. The priests afterward accused the verger of having stolen it, refusing to believe his statement; but even on his deathbed he persisted in his story, and so the cistern was drained and the crozier found.

After Napoleon's departure a governor was appointed to rule on behalf of the French Republic. Soon afterward the British fleet returned and won the Battle of the Nile over the French. Then the Maltese arose against the French garrison, which was blockaded by the British. After a gallant defense, lasting two years, the garrison finally was forced by famine to surrender.

After peace came Britain proposed to restore the island to the Order of St. John, but the piteous appeals of the Mal-

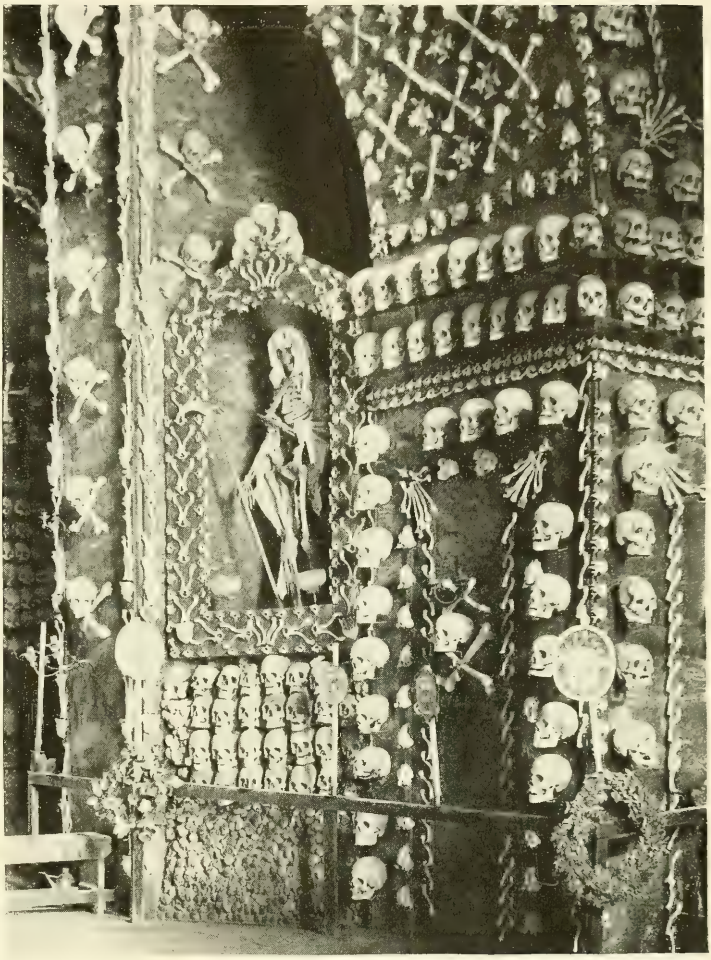
tese at last prevailed and Malta became incorporated into the British Empire — a very happy decision for its inhabitants.

Year in, year out, fresh trade has flowed through Malta, at last secure from every foe. The ships of the world soon thronged its harbors.

In 1825 the famous American frigate *Constitution* anchored at Malta, while after the battle of Navarino, in 1827, the British, French, and Russian fleets returned there also.

The change from sail to steam necessitated the provision of greater dockyard facilities for the British fleet in the Mediterranean, and millions of dollars have since been spent in Malta for this purpose, bringing employment and trade to the Maltese such as they had never known before.

The opening of the Suez Canal brought still further prosperity, while the increased size of warships necessitated further new docks and workshops, providing still more employment for the skillful and industrious inhabitants of the island.



Photograph by A. W. Cutler

THIS MALTA MORTUARY HAS FOR ITS MURAL DECORATIONS MORE THAN 2,000 HUMAN SKULLS

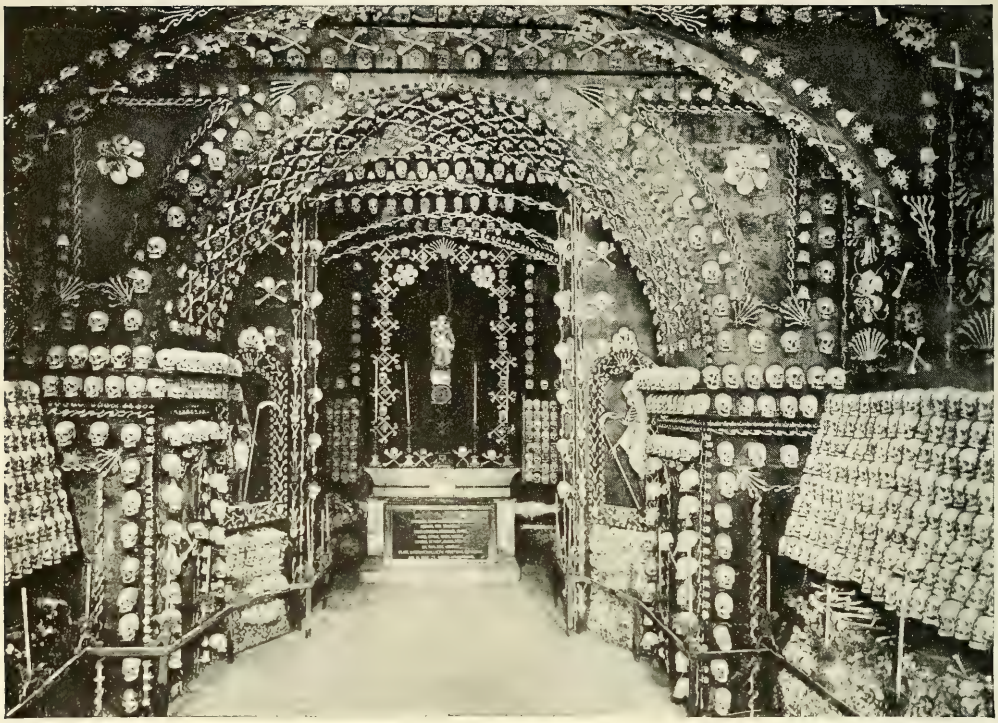
These grim relics belonged to the defenders of the island who were killed by the Turks in the 16th century.

BAFFLING EVIDENCE OF A REMOTE CIVILIZATION

Reference has been made in the preceding pages to the wonderful prehistoric remains in Malta. These are extremely abundant and afford much tangible evidence of the civilization of a past so remote as to be prior to the age of hieroglyphics and inscriptions and even of oral tradition. Their study, therefore, affords wide scope for theory, but the lack of absolute knowledge renders it a most tantalizing, though fascinating, pursuit.

Possibly the oldest existing evidences of civilization in Malta are the cart ruts previously mentioned. These exist in nearly every part of the island, cutting and intersecting each other to such an extent as to make the student almost despair of ever unraveling their mystery. If all the old tracks were traced and inserted on a map, the sites of the centers of habitation in prehistoric times would doubtless be revealed (see page 449).

In an arm of the Bay of Marsa Sci-



Photograph by S. L. Cassar

THE CHAPEL OF BONES IN VALLETTA: MALTA

Malta not only has ruins in which prehistoric man buried his thousands, as at Hal Saflieni, where the remains of 33,000 persons were found, but also such chapels as this, where the bones of the knights of the Middle Ages are preserved.

rocco, at the southeast end of the island, there are about sixty round, bottle-necked pits or wells cut out of the foreshore rock. A number of these are now under the sea. Directly over the mouths of some of them run two deep ruts, which lead into the sea and reappear on the opposite shore about a quarter of a mile away.

STORAGE WELLS FOR OIL OR WATER

The original purpose of these wells is not known, but it has been suggested they were intended for storing fresh water, grain or oil and were built at the edge of the water for convenience of shipment, thus suggesting evidence of foreign trade.

Black tufa stone rubbers were imported from Sicily and obsidian from the Greek islands has also been found. Similar pits, however, are found at the top of the high cliffs near a prehistoric village called Bahria.

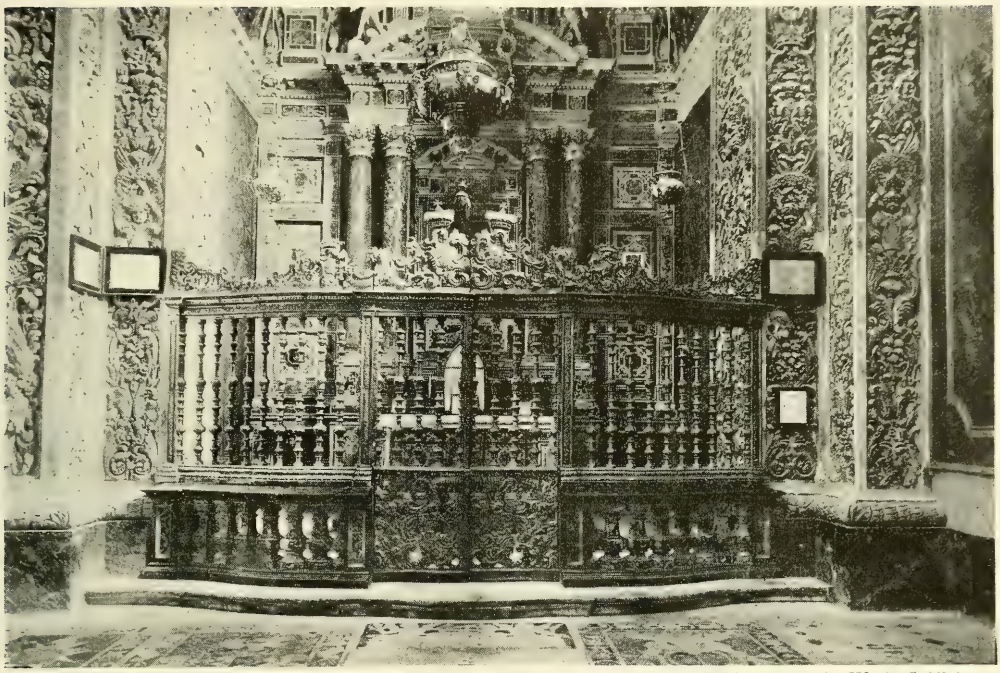
Near this site is a megalithic ruin called Borg en Nadur, which recalls in shape those curious Sardinian towers, the nuraghi,* and the cart tracks appear to lead from that place to another neolithic erection on the opposite shore.

Possibly the Phœnicians utilized the Stone Age erections for their own sacrificial purposes, as a votive pillar was found in this neighborhood having an inscription in two languages, recording in Phœnician a vow to Melkarte, Lord of Tyre, and one to Hercules Archigetas in Greek.

The prehistoric remains consist chiefly of temples, villages, dolmens, menhirs, storage places, and tombs.

The best-known temples are Gigantia, in Gozo, the small island four miles northwest of Malta, and Hagar Kim, Mnaidra, Corradino, and Tarxien, in Malta (see also page 473). The last

*See "Little-known Sardinia," by Helen Dunstan Wright in the NATIONAL GEOGRAPHIC MAGAZINE for August, 1916.



Photograph by W. A. Griffiths

THE SOLID SILVER GATES OF ST. JOHN'S CHURCH: MALTA

When Napoleon stopped at the island on his way to Egypt he expelled the Knights of Malta, confiscating their property and that of the Church. These silver gates were hastily painted, in the hope that they would escape notice, but in vain. They were subsequently redeemed at a great price.

named was discovered very recently and is only partly excavated. The unique underground temple of Hal Saflieni belongs in a class to itself.

THE GENERAL DESIGN OF MALTA'S PREHISTORIC TEMPLES

The general design of the temples consists of two oval or elliptical apses connected along the lesser axes by passages, at the far end of which is generally found the principal altar or object of worship.

The passageways appear to have been covered over with flat slabs and the oval chambers on each side domed, the corbeling of the walls being very strongly marked.

The compass direction of the passages leading to the principal altar varies in each temple, which was built to suit local topography. There does not appear to be any evidence of orientation or suggestion that the altars faced any special heavenly body. The majority face south or southeast.

The ruins of Hagar Kim ("Standing Stones") crown a barren, rocky hill on the south side of Malta, about a mile from the shore. The little islet of Filfla alone breaks the wide expanse of deep Mediterranean blue.

Large numbers of massive stones, some weighing several tons, were placed on end, side by side, each being joined to the next with great skill. On top of these were placed horizontal layers of flat stones, mortised together with great accuracy.

One pillar rises conspicuously above the ruined walls. Near it, on the outside, is an altar erected before a sacred stone, while a small hole pierces the wall to communicate with an inner sanctuary and through which the priest or priestess possibly consulted the oracle.

The top of the tall pillar is hollow and shaped like a grave, and theorists suggest that possibly here infants were sac-

A CHURCH IN MALTA READY FOR ITS FEAST DAY ILLUMINATION

Note the hundreds of electric-light bulbs in elaborate design on the façade.

Photographs by S. L. Cassar

A RELIGIOUS PROCESSION IN MALTA

The Maltese are deeply attached to the Church of Rome, and it is said that in no other community of equal size are the religious edifices so numerous and so beautifully decorated. The first Christian bishop of the island, legend tells us, was Publius, whom Paul converted.

rificed or the dead exposed to birds of prey, as is done in the Indian Towers of Silence.*

STONE FIGURES WITH PLAITED SKIRTS

When Hagar Kim was explored various interesting relics were found. One was a four-sided pillar with a flat, round top, possibly a sacramental altar. Each side is decorated with pittings at the edges, while the centers contain carvings of a many-leafed plant growing out of a vase. This decoration may represent the Tree of Life.

The most remarkable find consisted of seven stone carved figures of steatopygous females, some draped with plaited skirts and others apparently nude. Possibly they were originally painted entirely red, as red ocher paint is still largely visible.

One figure has a sort of pigtail behind, which might also have served as a handle to permit the image to be carried in a procession. None of them had heads, although sockets were found into which detachable heads could be fixed.

These figures suggest that they were worshiped as the Mother Giver of Life. They are sometimes described as the Seven Cabiri of the Phœnicians, to which nation all Maltese antiquities and even the race itself were until recently ascribed. Subsequent discoveries have proved beyond doubt, however, that these images were of neolithic age.

THE MALTESE LANGUAGE HAS NO WORD FOR "FATHER"

In connection with the worship of Matriarchy, it is curious to note that the Maltese language contains no word for "father" which conveys the idea of a head of a family. Their word "missier" literally means "instrument of generation" and suggests the time when descent was reckoned maternally rather than paternally.

About half-way between Hagar Kim and the shore is the neolithic ruin of Mnaidra. This resembles in general plan Hagar Kim, but is rather more ornate and better preserved. Many of the doorways and altar stones are decorated with pittings or are finely polished. This doubtless accounts for its local name of the "King's Palace," Hagar Kim being called the "High Priest's Palace."

A special feature of Mnaidra is the double-table altars. These are flat rubbed stones a yard or two square, supported under the center by a stone pillar. The largest is called the "King's Bed," certainly a couch stony enough to insure an uneasy royal head.

Both at Hagar Kim and Mnaidra it is evident that dolmens were regarded as objects of special veneration. They may have represented the gates from this world to the next, through which all must pass, or they may have typified the abodes of the departed spirits.

A dolmen grave at Borg en Nadur has the lintel or upper cross-stone pierced in the center by a round hole, used perhaps in a sacrificial ceremony, so that the blood of the victim might fall on the occupant of the grave. Dolmen graves with a hole in the side wall-stone are much more common.

Near Mnaidra is a cave in which the remains of a peculiar kind of elephant were found, to which the name *Elephans Mnaidrensis* was given.

WELL-DIGGERS FIND A TEMPLE

The Corradino neolithic station stands on a broad plateau overlooking the Grand Harbor. The ruins are very extensive, consisting of several temples and a village. The ruins of the latter are distinguishable by being square instead of oval in shape, like the temples.

On the southern boundary of Corradino is the village of Casal Paula, which overlooks the broad, flat plain of the Marsa. In 1902 a well was being bored for some newly erected houses, when suddenly the foundations gave way and the whole disappeared into a dark pit. Investigation resulted in the discovery of an underground habitation which is without equal in the world.

This hypogeum, or subterranean structure, now known as Hal Saflieni, consists of three series of chambers excavated out of the solid rock, on three levels. It stood in the midst of a neolithic village.

* See "The Parsees and the Towers of Silence at Bombay," by William Thomas Fee, in the NATIONAL GEOGRAPHIC MAGAZINE, December, 1905.

MALTA CLAIMS A MILCH-GOAT POPULATION OF 10,000

Since Mediterranean, or Malta, fever has been traced to a micro-organism to be found in the milk of these perambulating "dairies," the goat boy is not as popular with visitors as he was in olden days.

Photograph by S. L. Cassar

HONEY MERCHANTS OF MALTA

The island was famous for its honey in ancient times, the name itself coming from the Greek word "Melita," meaning honey. In the Biblical account of Paul's shipwreck the name of the island is given as Melita (see text, page 451).

THE COUNTRY ROAD LEADING TO CITTA VECCHIA, THE FIRST CITY REBUILT BY THE KNIGHTS OF MALTA

Malta and the neighboring islands of Gozo, Comino, and Cominotto have a combined area of 118 miles, with a teeming population of 225,000. The fields of the islands are small and consist largely of terraces, the soil being walled up along the slopes of hills.

Photographs by S. L. Cassar

THE WATER-WAGONS OF MALTA HAVE TAIL-LIKE APPENDAGES

The operator walks in the rear of the cart and waves the sprinkler back and forth, thus covering the space between the curbs.

THE SOLE RELIC OF THE OLD NATIVE COSTUME IS THE PECULIAR BLACK HEADDRESS OF THE WOMEN, CALLED THE "FALDETTA"

The Maltese are a thrifty, industrious people. The women are noted for their black eyes, fine hair, and graceful carriage.

Photographs by S. L. Cassar

A REAR VIEW OF THE MALTESE EASTER BONNET

While farming is the principal industry in Malta, more than 5,000 women and children are engaged in producing the famous Maltese lace.

Two large upright stones mark the entrance below ground and near by was found a large quantity of heavy sling-stones, conveniently ready for use in case of emergency.

Drilled in the threshold floor are two holes the bottoms of which connect. Through the loop thus formed was passed a rope to tether the animal chosen for sacrifice. A large cave near at hand apparently was used as a pen for animals, the top being so low that a man could not stand erect in it.

Proceeding down the entrance passage, which is of course absolutely dark unless lit artificially, we notice on the left a round, well-like excavation. At first it appears to be an ordinary pit, but on closer examination a second inner well is seen, the top of the latter being closed by a tightly fitting lid. This was evidently used for special security. In it were found two stone figures of steatopygous figures similar to those found at Hagar Kim. The figures also had detachable heads, both of which, fortunately, were found.

Continuing, we pass a side cave now packed with human bones. At the entrance is a circular stone basin with a hole bored in its center and covering another pit which would form an ideal dungeon.

The passage finally narrows to a large dolmen-shaped doorway, and through this we pass to a lower floor, with a sudden drop of several feet. The absence of steps to the different compartments is puzzling, as it is open to doubt whether perishable wooden ones were provided when stone was available.

THE MYSTERIOUS MAIN HALL OF THE TEMPLE

We have now reached a long, silent cave which must have looked very weird when lit by a few hanging pottery lamps. In the center is a large upright stone.

Proceeding to the left, we climb a stone wall a yard high, also without steps, and pass through a doorway into a large circular cave which appears to be the main hall of the temple. At once the attention of the eye is called to a doorway carved out of the end of the cave at a height of several yards from the floor.

The doorway leads to a small oval cave at the back. On both sides are niches each of which probably contained a sacred pillar or other object of worship. Here the carving is beautifully worked and polished. Four other doorways lead to caves on the level of the floor. The general appearance of the niches suggests that the lower ones were excavated later and less carefully than the upper ones.

The ceiling of the room is decorated with ocher paint, partly in plain red and partly in squares alternately black and white.

THE HOLY OF HOLIES

Passing out of this room through a doorway erected on a step a yard above the floor, we come to what is called the "Holy of Holies," the upper portion of the room being carved and polished very ornately (see page 468).

A small room to the rear contains a stone table, over the middle of which is carved a stone hook from which some sacred object or sacrifice or possibly a lamp was suspended. The doorway of this little room has grooves for fitting a closing slab, but this would also shut out the air and the occupant would soon die of suffocation. It is remarkable that the "Holy of Holies" is the only room not decorated with paint.

In the illustration (see page 468) may be noticed a hole in the right-hand curved support, while another is near its foot. The left-hand upright of the entrance is also bored with a tie-hole. From these three places it is supposed a curtain or screen was hung to hide the holy place from the sight of persons using the steps leading down to the lowermost rooms.

In the floor, in front of the left niche, are two holes closed with plugs flush with the ground. In the right hole two pairs of ram's horns were discovered, doubtless having some religious significance.

Retracing our way from the Holy of Holies through the main hall to the room containing the large upright stone, or menhir, and turning to the left, we proceed toward another set of caves. It will be noticed that in this passage the rock, instead of sounding solid to the tread, suddenly sounds very hollow, as if there were a well or room not yet opened.

Photograph by S. L. Cassar

THE IMTARFA BARRACKS AND THE NOTABILE RAILWAY TERMINUS (IN THE FOREGROUND): MALTA

Notabile, or Citta Vecchia, is seven miles inland from Valletta, and is still popularly known as *Medina* (Arabic for town). In Roman times this city was the fortified capital of the island. According to legend, it was here that St. Paul dwelt during his three months' stay on the island, following his shipwreck.

What wonderful store of archæological wealth is perhaps here awaiting that opening!

The walls along the right of this passage are full of drill-holes an inch or less in diameter. This shows the method of excavation employed. Holes were drilled with flint points and the intermediate portions chipped away with stone hammers or chisels, several fine specimens of which were found.

Continuing along this passage, we come to another room, into which we enter with a sudden drop of a yard. Looking through the entrance doorway, the wall on the left appears quite straight at first, curving round at the end, while the right wall is very much sloped.

Descending some modern stone steps, a round recess on the left is seen. In this place a person could stand without being observed by any one approaching along the passage, while a spy-hole is provided for the use of the occupant of the recess. Two holes are also bored in the walls of the recess to spy into the adjoining cave.

AN ORACLE CAVE AND A SOUND-MAGNIFYING CHAMBER

Passing the recess, we come to a square entrance into a small round cave a yard or two in diameter. Possibly the oracle was kept here. A little farther in the cave, at about the level of a man's mouth, is a hemispherical hole in the side wall about two feet in diameter. Here it was noticed only a few months ago that any word spoken into this place was magnified a hundred-fold and audible throughout the entire underground structure.

A curved projection is specially carved out of the back of the cave near this hole and acts as a sounding-board, showing that the designers had a good practical knowledge of sound-wave motion. The impression upon the credulous can be imagined when the oracle spoke and the words came thundering forth through the dark and mysterious places with terrifying impressiveness.

Before leaving the oracle room, special notice must be taken of the wonderful ceiling paintings, which are the finest in the temple. Possibly the design of the spirals and disks may have some mystic meaning in connection with the passing of the human soul through various cycles.

THE PIT OF SERPENTS?

Proceeding to the next room, a distant view of the Holy of Holies is obtained. This anteroom has several curious features. The roof is supported—quite unnecessarily for structural requirements—by two menhirs differing in design. The one to the right is similar to the sacred pillars at Hagar Kim (see page 457) and to the high altar of Tarxien (see page 477).

On the left is a mysterious pit. The low stone wall on the left is grooved to receive an upper stone, thus increasing its height. The pit is shaped like a funnel, with a curious slip-way worn out just below the hole in the opposite wall which communicates with the main hall.

After sloping downward and inward, the pit widens considerably and is sufficiently deep to prevent even a tall man from climbing out. It has been thought that sacred serpents were kept in this pit, the curving sides of which would prevent their escape. Possibly after the serpent had been lifted up, as was done by Moses in the wilderness, and due worship made, it would be returned to its lair through the hole in the wall. The larger entrance on the opposite side would permit of a man or woman being cast among the serpents to be stung to death.*

Passing to the right of the pillar and then sharply turning to the left, we descend a very finely worked series of seven steps into the lowest and innermost rooms. These steps are erected on the lintel of a huge dolmen. Opposite the lowest step and isolated by a deep moat-like trench is a small inner cave wherein a priest or vestal might have sat and communed.

There are no steps to this small room and it is difficult to reach. On its right hand is a small spy-hole, through which all persons at work in the moat can be seen. Adjoining the moat and divided only by another doorway are several

* See also an account of the serpent pits in the temples of the Incas, in "The Wonderland of Peru," by Hiram Bingham, NATIONAL GEOGRAPHIC MAGAZINE, April, 1913.

A STONE AGE TEMPLE SHOWING SACRIFICIAL TABLES IN THE FOREGROUND: MALTA

Massive stones, some weighing several tons, are placed on end side by side, each being joined to the next with great skill. On top of some of these are horizontal layers of flat stones accurately mortised together (see text, page 457).

similar compartments, the last being situated almost directly under the serpent pit. The innermost room of all has four openings about a foot square leading to four tiny caves, which might have been used as places for the deposit of treasure.

This completes the itinerary of the temple, which is so complex that one can only speculate as to the use or significance of its many extraordinary features.

A MAUSOLEUM FOR 33,000 PERSONS

In 1906 the work of exploration was begun. Most of the rooms were found to be half-filled with earth, human bones, and broken pottery. It has been estimated that the ruins contained the bones of 33,000 persons, mostly adults. Practically all were found in the greatest disorder, and there had evidently been no regular burial of a complete body.

With regard to the original use of the hypogeum, opinions vary. It may be that it was a temple carved underground for the use of spirits who had left this world, providing them with the same type of temple as that in which they had been accustomed to worship above ground; or it may have been a sacred college, wherein the priesthood were initiated into the mysterious beliefs of those days.

CURIOUS FINDS AMONG THE BONES

Whatever may have been the original use, there is no doubt that it was used in part as a burial place for the bones of the dead after a previous burial above ground.

A large number of personal ornaments and votive offerings were found mixed with the bones, and these afford much insight into prehistoric beliefs and customs. Besides the large stone female figures already mentioned, several tiny alabaster replicas were found.

A small carving was also found of a woman with a small head and large lower figure, lying on her side asleep on a four-legged couch. Her head is placed on a shaped neck-rest. The figure is clad in quite fashionable flounces and plaitings and was evidently painted red.

THE MAIN HALL OF THE TEMPLE OF HAL SAFLIENI: MALTA

Four doorways lead from this chamber to caves on the level of the floor (see text, page 463).

Another carving shows a woman, similarly clad and proportioned, lying face downward on her couch, her hands stretched forward on either side. It is suggested that the former represents a priestess dreaming near the sacred places in the hope of obtaining inspiration to declare the words of the holy oracle, while the second figure represents her in the act of worship.

A large number of axe-shaped pendants of jade or polished stone were found, suggesting some connection with the symbolic axe worshipers of Crete. Two objects representing fish were found, one being placed on a plate. Doubtless the fish was venerated as an emblem of the Giver of Life, and possibly the adoption of a fish as the sign of a fellow-Christian in the Catacomb days of Rome was the survival of an old belief. Today in Malta fish is usually eaten on the first night spent in a new house, to bring good luck.

Symbolic stones carved into the shape of sea shells, votive lamps, real sea shells, vertebræ of fish, artificial seeds, cones, tiny pillars, large spheres, and holed

THE FAMOUS HOLY OF HOLIES IN THE SUBTERRANEAN STRUCTURE KNOWN AS THE HYPOGEUM OF HAL SAFLIENI: MALTA

One of the remarkable features of this great chamber is the entire absence of any mural designs. This is the only room not decorated with paint. A curtain or screen is supposed to have hung before this holy place to conceal it from persons using the steps leading to lower chambers (see text, page 463).

stones were found in abundance, doubtless all having some special significance.

BEAUTIFUL POTTERY, IN EVERY INSTANCE SHATTERED

Much beautiful pottery was found, practically all broken. This may have been intentional, as typifying the snapping of the thread of life. The pottery varied in kind from rough clay vessels to finely polished and glazed ware, ornamented with spirals worked with flints. Some bore bright lines of red ocher of artistic design.

Perhaps the most interesting piece of pottery found was a black polished plate, on which was drawn with flint the figures of several large horned bulls of mottled color, all instinct with life. The species of animal was identical with that carved

in high relief in the "bull sanctuary" of the latest and most wonderful discovery of all, the Stone Age Temple of Tarxien.

A CEMETERY FOR CRIMINALS LEADS TO AN ASTOUNDING DISCOVERY

Tarxien is a continuation of the village of Casal Paula, where the hypogeum of Hal Saflieni is situated. It owes its discovery to the following circumstances:

A few years ago it was necessary to find a new burial place for criminals, and a site was selected on the plateau overlooking the dockyard from the southeast. While digging the foundations for the cemetery chapel the earth was found to have been artificially deposited, as it contained blocks of hand-wrought masonry. The workmen, talking among themselves, elicited the fact that in the adjoining field large blocks of stones had also been struck a few feet below the level of the soil.

As the work of excavating the hypogeum in the village was still fresh in their minds, the laborers thought possibly a similar structure might exist here.

The facts were reported in 1913 to Prof. T. Zammit, C. M. G., who had supervised the final excavation of the hypogeum. In July, 1915, he caused the blocks to be cleared of soil. They were found to be the tops of the walls of a prehistoric temple of the same shape as those of Gigantia, in Gozo, and Hagar Kim and Mnaidra, in Malta.

WAR FAILS TO STOP RESEARCH

The work of excavation was carried out during the hottest months of 1915 and 1916, when the soil was driest, so that it could be carefully sifted to prevent the loss of the smallest objects which might be of interest.

Here, despite the tropical sun, a small band of students, among whom was the writer of this article, labored under the able and genial guidance of Professor Zammit.

The drain of war expense on the funds of the Malta civil government permitted only a very small expenditure of money on this work during 1917 and 1918, but it was sufficient to show that the temple and its precincts extended beyond its present known limits and where secrets unknown as yet to the world may still lie hidden.

The examination of the upper layers of earth over the site of the temple brought to light quantities of Roman and Punic pottery, practically all in fragments.

A lower layer revealed a new type of pottery, among which were found small heaps of burnt human bones. Beads, necklaces, clay objects representing birds, fishes, &c., small figures, bone ornaments, and a bronze dagger were found in this same layer. The dagger gave the clue to the mystery—a Bronze Age depository of funeral urns had been found.

This was very valuable, from the light it shed on the life and customs of the Mediterranean Bronze Age people, who probably flourished about 2000 or 3000 B. C.

Inside the cinerary urns were also found foods—wheat, beans, etc.—for the journey in the next world, as well as small objects and ornaments which had been very dear to the departed in their lifetime.

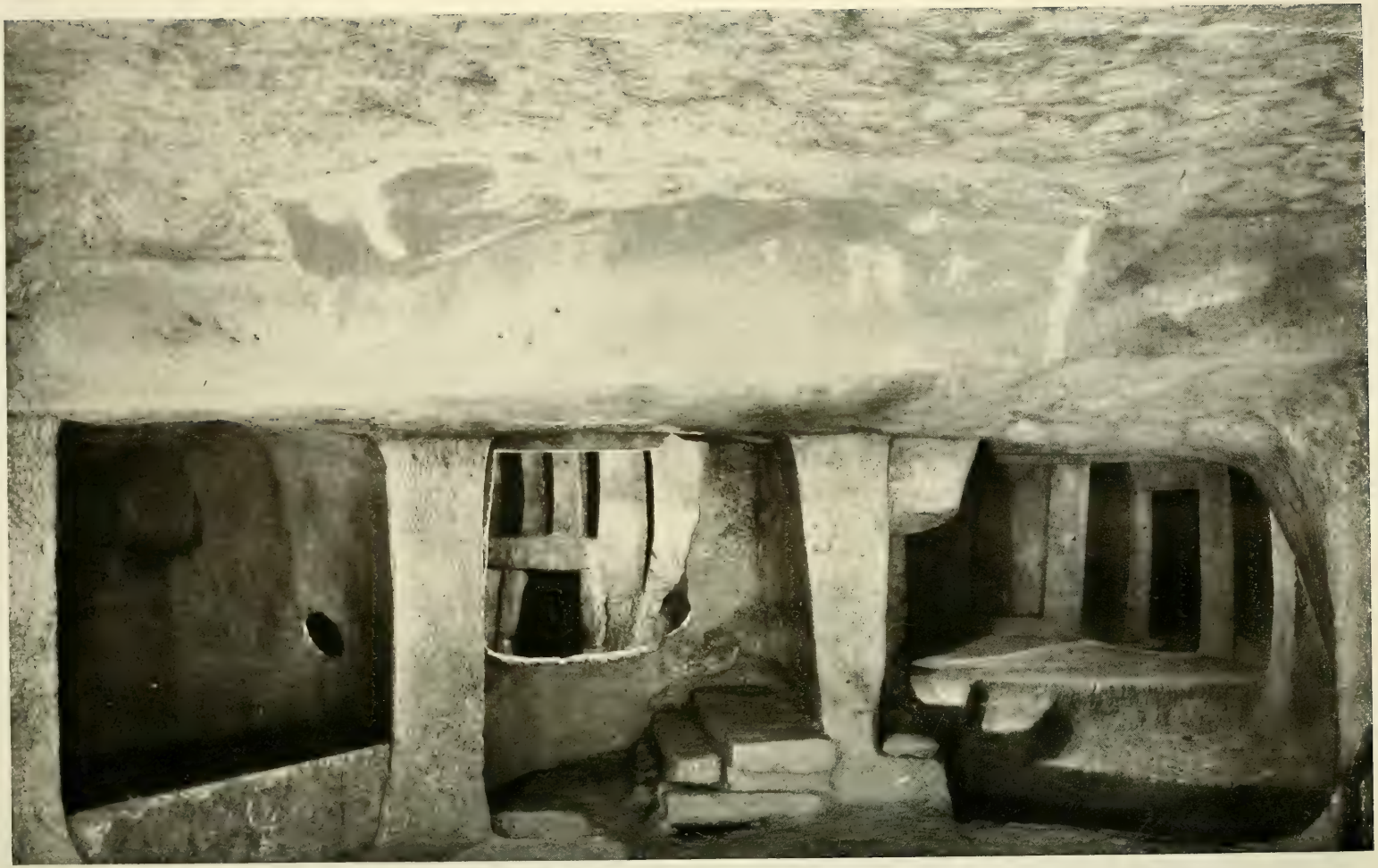
Doubtless the Bronze Age dwellers in Malta had heard the tradition that the tall stones standing, abandoned, deserted, and overgrown with weeds, had once been a sacred place, while in any case such high walls as were still standing formed a good shelter for their funeral fires. Hence the Bronze Age cemetery on this spot.

The Bronze Age layer was strongly marked with charcoal and ashes. Below this came several feet of fine sand, containing no stones or broken fragments of rock and no traces of any Bronze Age pottery or metal, clearly showing that this layer had been deposited by centuries of wind and rain, untouched by the hand of man.

All these layers were removed by the excavators with careful and reverent hands, as was due those far-off and forgotten worshipers of the Unknown God. Finally the floor of the temple was reached and cleared as perfectly as possible.

A TOUR OF THE TEMPLE

The length of the buildings from end to end is about 50 yards, while the level of the temple floor is about 7 feet below that of the field.



A VIEW OF THE MAIN HALL AND THE HOLY OF HOLIES FROM THE ORACLE ROOM OF THE HAL SAFLIENI TEMPLE (SEE PAGE 465)

THE CEILING PAINTING IN THE ORACLE ROOM IS THE FINEST TO BE FOUND IN THE HAL SAFLIENI UNDERGROUND GALLERIES

A word spoken in this room is magnified a hundredfold and is audible throughout the entire structure. The effect upon the credulous can be imagined when the oracle spoke and the words came thundering forth through the dark and mysterious place with terrifying impressiveness (see text, page 465).

LOWEST DUNGEONS OF THE HAL SAFLIENI RUINS

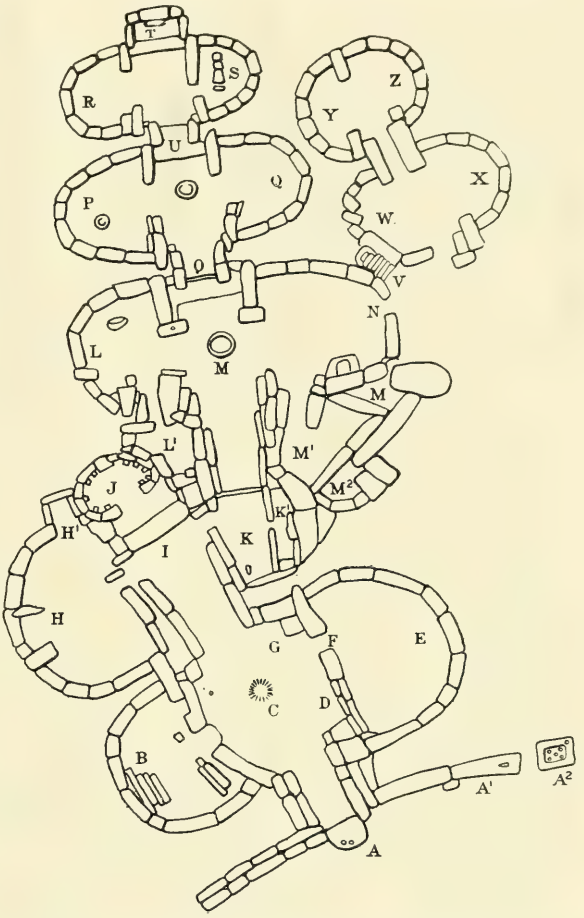
This innermost room of the subterranean galleries has four openings leading to small caves, where the temple's treasures may have been secreted (see text, page 466).

Let us make a tour through the temple, following the rough plan reproduced on this page.

We stand first on a semicircular stone, A in the plan, in which are drilled two holes connected at the lower ends. This is the ordinary tie-hole of Stone Age times and may have been used to tether sacrificial animals outside the temple. On each side can be traced large horizontal blocks of stone extending in a semicircular direction, doubtless the fore-court, or public place in which the people assembled before divine service.

These large blocks apparently served as foot-stones to support large upright masses of masonry forming the outer wall of the temple. One of the blocks has a conical hole in it, besides several small circles engraved on it (A^1), all doubtless having some religious significance or used in the public worship or sacrifice. A few yards farther on is a stone (A^2), about two yards square, in which are five holes, some of oval shape and some round.

For what purpose this stone was used is not known. Possibly it was employed in the ceremony of ablution, as a somewhat similar contrivance was found in the Stone Age temple a mile away, at Corradino, shown on page 476. It has been suggested that this was the altar of sacrifice, and that the holes were to catch the blood of the victim. This is possible, but the sacrificial victim must have been killed first, as no tie-holes exist in these stones.



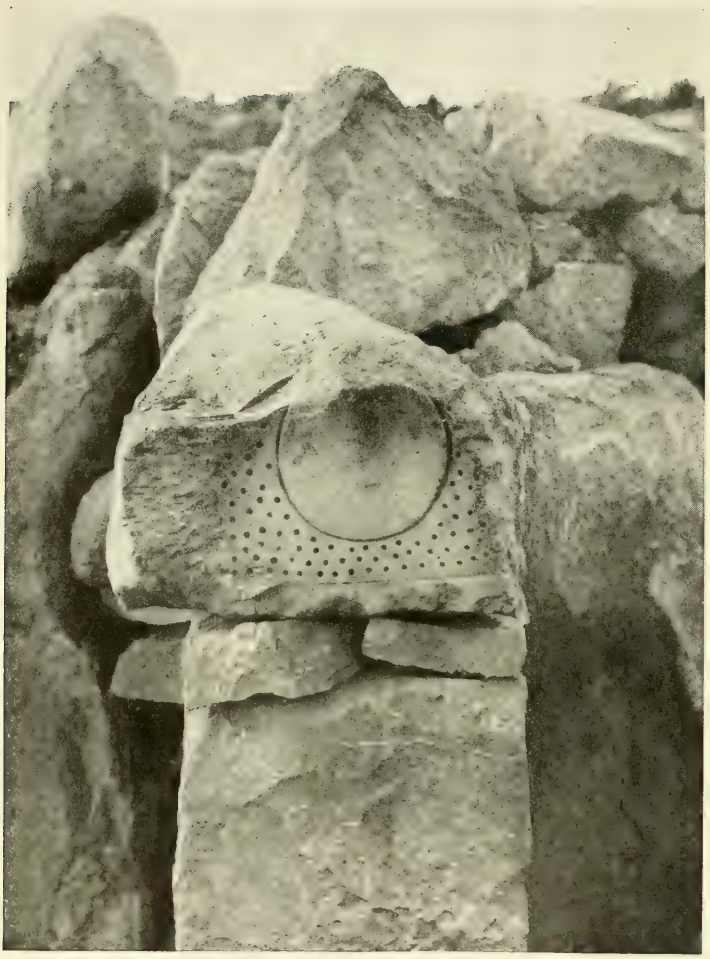
A SKETCH SHOWING THE ARRANGEMENT OF THE CHAMBERS OF THE STONE AGE TEMPLE OF TARXIEN

These ruins have been unearthed by a band of students working under the direction of Prof. T. Zammit, C. M. G. The work proceeded throughout the stressful period of the World War, despite limited government appropriations.

After the temple had fallen out of use prehistoric boys may have found that this formed an excellent bagatelle board, and by using rounded stones and possibly numbering the holes quite a good game could be played. A quantity of round stone balls was found on this site.

Returning to position 1 on the plan, we enter the passage A C and arrive in the building marked B E. Facing to the right, there is a beautiful carved dado round the room. In the center is the broken lower portion of a huge female figure, of which only the feet, fat calves, and fluted skirt now remain. When complete the figure was probably seven feet high. It stands on a slab of stone ornamented with egg-shaped symbols and would lead to the inference that it was the image of the Goddess of Life and Fertility. Carefully placed near her feet was found a sacred cone, possibly representing the male element.

Standing in position C of the plan, which is a spot worn away by innumer-



A MYSTIC STONE PILLAR MARKING THE BEGINNING OF THE INNER SANCTUARY OF THE TEMPLE AT TARXIEN

On top of the pillar is a second stone on which is carved a circle surrounded by pit-marks. Some students surmise that the circle represents the sun and the pit-marks the stars (see text below).

able fires, and turning our back on the goddess, we see beautifully carved altar tables and an altar, in front of which is a small font decorated with pit-markings, an ornamentation noticed in other prehistoric temples.

Apparently this font had been painted red with ocher, from which it might be inferred that the ceremony of sprinkling blood for cleansing from evil was carried out even in those far-off days.

Behind these pillars is a small side chapel very beautifully decorated. One slab contains a frieze of eleven goats, while another has four goats, a fat pig, and a horned ram or buck.

Looking again from position C to G in the plan, we see a large carved stone table or chest in front of an altar or oracle place of the dolmen type so noticeable in all neolithic temples. The large altar stone is hollow, with a detachable semicircular fitting.

Inside was found a very fine curved flint knife, as well as fragments of beautifully polished Stone Age pottery. It might be observed here that possibly all votive vessels were broken after the sacrifice, to denote the completion of the ceremony, as practically none were found complete.

Proceeding through position C to I, we reach the principal altar of the temple. The curved façade of the floor of the "chancel" cannot but arouse admiration for the wonderful skill of those ancient workers, whose only tool was a flint. On the left corner of the carved stone can be seen a round tie-hole. The stone a little to its right and standing back two yards from it marks the beginning of the inner sanctuary, which consists of a semicircular building with five stone seats on each side of the altar. These possibly were either for images or for the officiating priests.

On top of the stone at the left entrance to the inner sanctuary is another lying horizontally with a square end on which is carved a circle surrounded by pit-marks (see illustration on this page).

Without doubt this had some reference to their religious beliefs, but the stone on the opposite side is missing.

It has been suggested that the circle represented the sun and the pit-marks the stars, while others suggest a phallic solution. A stone was found carved with two phallic pillars standing on a base decorated with pit-marks. When the two designs are considered together, possibly a key to their ceremonies and beliefs may be found.

The corbeling, very noticeable in the right wall of the inner sanctuary, would show that this building was domed over.

Entering room H, which is very badly damaged, we see a tiny dolmen-shaped altar marked H^1 in the plan. The top of the altar table has a hole in it, fitted with a plug. Through this a memento, such as a small bone for each sacrifice, was possibly placed for temporary custody.

AN ALTAR IN THE TARXIEN TEMPLE, BENEATH WHICH APPEAR THE FAMILIAR PHALLIC SYMBOLS OF THE CONE AND THE BALL (SEE TEXT BELOW).

Returning to position I, we enter a new and earlier temple, in which the decoration is less ornate. We first notice a small side chapel, K^1 in the plan. Entrance is gained through the doorway, which is so low that one is required to bow in passing.

Immediately opposite is a sacred stone of worship, broader at the top than at the bottom. Its significance is not known, but stones of this design appear in the "Holy of Holies" at other temples. On the left of this stone is a corner seat for the priest, while on the right is the altar (see illustration above), with its familiar phallic symbols of the cone and the ball.

In the passage leading from position K to O, the investigator sees holes in the masonry on each side, indicating that barriers and curtains were hung here. A straight view can be obtained down the aisle leading to the Holy of Holies, where the sacred stone faces the visitor. In the center is a much-burnt stone fireplace full of ash, M in the plan.

Looking toward the northern end of this oval-shaped building, we see at the far end an entrance, afterward closed by a huge block of stone.

Near the Sacred Stone is a round stone

A CORNER OF THE TARXIEN STONE AGE TEMPLE, SHOWING THE CARVED ALTARS, TWO SACRED CONES, AND A TOMB: MALTA

The dark patch on the right of the photograph marks the site of funeral pyres. Tarxien is a continuation of the village of Casal Paula, where the Hypogeum of Hal Saflieni was situated (see page 459).

A CURIOUS STONE WHICH MAY HAVE BEEN USED BY THE ANCIENT INHABITANTS OF MALTA IN THE CEREMONY OF ABLUTION

A quantity of stone balls was found near this slab, which suggest the possibility that at a later period it may have been used for games (see text, page 473).

THE MAIN ALTAR OF THE TEMPLE AT TARXIEN: MALTA

The graceful carving awakens admiration for the prehistoric stone-cutters, whose only implements were sharpened flints (see page 474).

plug. Here, it may be imagined, the sacrificial ox was brought in and tethered. Armed with a heavy stone axe, the priest felled the animal, completing the sacrifice with a sharp flint or obsidian knife. A huge basin or laver was used in the ceremony of purification.

The sacrifice was cut up on a large stone between the laver and the fireplace. This stone has a deep, round hole into which the blood of the sacrifice drained. The portions to become the burnt sacrifice were there cut off and placed on the sacred hearth. A large stone table on the right contained no drainage hole and doubtless was the place where the burnt offerings and oblations were dedicated to the gods.

Opposite this table of oblation is a passage leading to a small side chapel, marked M^1. This contains a small altar, while on the walls are carved in bold relief three animals—a bull, a sow, and a second bull facing the first (see illustration on page 478). These carvings are among the earliest known of this type.

Two large bull's horns were found carefully hidden under the entrance to this sanctuary. It appears, therefore, that the worship of the sacred bull, so widely spread and still existing, was carried on in Malta just as the Minotaur was worshiped in Crete.

Two doorways on the ground level, about two feet square, lead from two small rooms M^2 and M^3, where possibly goats or lambs were kept ready for sacrifice.

Returning to room L, M, we mount a long horizontal slab just beyond the round hearth. Here we are much struck with a beautifully carved barrier about a yard high. This evidently marked the part of the temple dedicated to the uses of the priests.

Between the spirals are carved two cones. Mounting over this and again noting the various curtain and door slingholes in the side walls of the passage, we come to another oval building, P Q in the plan. This has similar features to the previous room, but is smaller and entirely without carved work except a stone screen on each side, finely decorated.

A BULL AND A SOW CARVED IN BOLD RELIEF ON THE WALL OF ONE OF THE CHAMBERS IN THE TEMPLE OF TARXIEN (SEE PAGE 477)

These are among the earliest carvings of this type known. Near by, carefully hidden under the entrance to the sanctuary, were found two large bull's horns, suggesting that this animal was worshiped in Malta as the Minotaur was worshiped in Crete (see "The Sea Kings of Crete," by James Baikie, in THE GEOGRAPHIC for January, 1912).

Between the screens and the entrance rose two huge pillars, now broken off at ground level. In the center of the room is a sacred hearth, while apse P contains a well-preserved altar and a font, the latter being pit-marked and still bearing traces of red ocher. In a tall slab opposite the carved screen is a black spot on the edge near the floor. When excavated the bottom of this pillar was found to be adorned with five pebbles let into the stone, three in the top row and two below at the ends. No convincing explanation has been suggested for these stones.

We now come to the last and final room, R S T U. Here no stone barrier bars the way, but the holes for the screens can still be seen.

The last apse is the smallest of all, and the inward inclination of the stones indicates that the rooms were domed over.

With feelings of awe we retrace our steps down the main aisle, and, having arrived at Room L-N, we turn to the left and find an exit marked N in the plan. On each side is a sort of pulpit on which the priest might have stood to address the worshipers.

Possibly an image or round stone ball, of which several two feet in diameter were found, was placed on this pedestal.

The exit leads to a much more roughly built series of rooms, marked W-X and Y-Z. Outside exit N and on the left is a flight of steps, V.

SECRETS OF THE PAST AWAIT DISCOVERY

Beyond these apses sufficient soil has been removed to show that the prehistoric buildings extended for a considerable distance into the next field, and that the walls are those of square, and not oval, buildings. Here it seems likely that the laity lived, and it is hoped that when funds are once more available further research may be carried out to delve into the secrets of the long-forgotten past. Here we may find one more clue in our attempt to solve the question whence man came, in the hope that we may find whither man goeth.

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A MIND'S-EYE MAP OF AMERICA

By Franklin K. Lane

Formerly Secretary of the Interior

Author of "A City of Realized Dreams," "From the Warpath to the Plow," "The Makers of the Flag," "The Nation's Pride," etc., in the Geographic Magazine

AMERICANIZATION is a very broad and inclusive term. The first part of it is that we should know what America is. I find in dealing with this problem of making the foreign-born understand what Americanization is that the first great difficulty is to make the American-born realize fully and be conscious of America in all its various senses and moods and spirits. And one of the things that I should like to conduct, if I were free to do so and had the means, would be a real geography class.

We are all fascinated by pictures. Recently I have induced the motion-picture industry of the United States to enlist itself in this cause and produce Americanization pictures, and give upon its screens slogans and suggestions and apothegms that will stimulate the American ideal, because I have the notion that there is something in the United States that we call Americanism that is distinctive, that no other country has, and that it is expressed in the lives of our people, in their work, in their philosophy, in their tradition and history.

One of the pictures that I have suggested is a map of the United States, with which I find many are not familiar. Visualize the map of our country, and it will become apparent how large in material resource and how large in activity, intellectual and spiritual, the United States is.

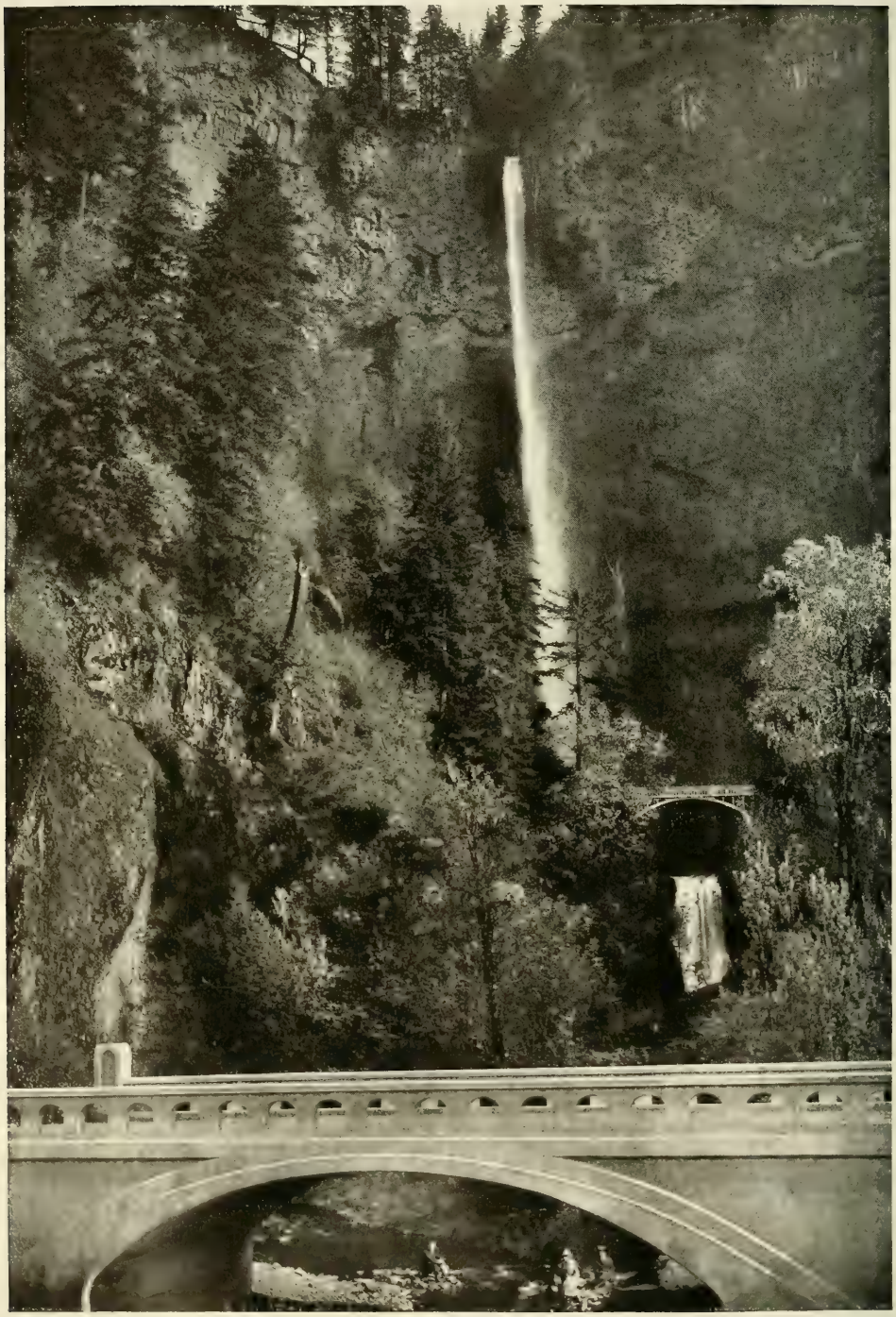
As I say, we are all fond of pictures. We love some because of their color, some because of line, some because of depth of background, some because of their historical significance, some because of the story in the picture. To me the most fascinating of all pictures is the map of the United States. Let us look for a moment at some of the remote parts of this map, and learn what is and what may be. Then we will have renewed confidence in our future.

FROM TROPIC TO ARCTIC IN HAWAII

If you go to Hawaii you will find that all of the land grants which were made originally to the chiefs, the favorites of the kings, ran from points upon the shoreline up to the top of the mountain.

You will see here a point of land running out into the sea, and there a point of land; and because they did not know the science of surveying and had to take these natural points, they drew the line straight up from these two points to the crater that was the summit of the mountain.

A year and a half ago I took a trip on one of those islands, and I started at the bottom, on the very edge of the sea, where the rice grows, and then went into sugar-cane, and then above into orange orchard, and then into coffee plantations, and then, all the time ascending, into fruit lands—peaches and other fruits—and then up into wheat lands, and then



Photograph from Lloyd W. McDowell

MULTNOMAH FALLS, ON THE COLUMBIA RIVER HIGHWAY

This recently completed scenic route of the Northwest parallels the picturesque Columbia River. Nearly all motor cars stop on this arching bridge, which affords a view of both stages of Multnomah Falls, with a total height of 740 feet, making this the second highest cataract in the United States.

Photograph by L. D. Lindsley

WHEN THE WATERS OF LAKE CHELAN ARE ASLEEP: WASHINGTON

This mountain gem, more than 50 miles long and from one to two miles wide, is guarded by peaks which tower from 4,000 to 5,000 feet above its waters, by turns placid and restless.

Photograph by Ansel F. Hall

THE GATES TO YOSEMITE VALLEY, CALIFORNIA, FROM THE SLOPE OF SENTINEL DOME, NEAR GLACIER POINT

Snowshoes are better than skis on such a slope as this, more than four thousand feet above the valley floor. To the right is the flat face of El Capitan. Cathedral Rocks close the view to the left. Far below is the road to the railway terminus at El Portal, ten miles down the valley of the Merced. The dog in the picture is a famous character in the Yosemite, where all other dogs are excluded. He is "Bob Townsley," the National Park Service lion tracker, and "as good a ranger as any man in the service."

into grazing lands, until I came to the snow on the top of the mountain. So that in that small tract of land, driving in an hour's time from the sea to the summit of the mountain, one sees everything that can be produced, from the tropics to the Arctic Circle.

That segment of that island gives a picture of the United States, because we have capacity in this country to produce all of those things which man requires, either in the temperate or the semi-tropical zones or even in the eternal snows of the north.

ALASKA'S NEW RAILWAY

In Alaska we are building a railroad; it is almost built; five hundred miles long, running from the sea straight north to Fairbanks and into the Arctic Circle. That is a government enterprise. The road is as well laid as the Pennsylvania. It has been built, without graft and without pull, out of government funds for the benefit of that territory, so that it may be opened up.

The very far end of Alaska is Seward Peninsula. Worthless? It looks so. Yet a woman came in to see me some time ago carrying a receipt for forty thousand dollars' worth of tin that she had got out of a river bed there.

THE REINDEER AND THE MUSK-OX

This side of Seward Peninsula we have the great grazing grounds of the reindeer. Twenty years ago a man conceived the idea that the Alaskan moss would support Siberian reindeer. He brought 1,200 animals over; that herd has multiplied until it is now 165,000. They feed on moss all the year round. Eskimos guard them.

The other day Stefansson, who made that great swing around North America, and added one hundred thousand square

Photograph by Ansel F. Hall

HALF DOME AND CLOUDS REST, YOSEMITE NATIONAL PARK: CALIFORNIA

The photograph was made December 13. Note the chief ranger's winter costume—bare head, short sleeves, no coat or gloves. Snowshoeing with fifty pounds of weather instruments is more *work* than *art*.

miles to the world's known area in the Canadian Arctic, while living for five and a half years on the resources of the frozen north, called upon me and said that in the northern part of Canada the musk-ox flourishes.

The musk-ox is valuable for its hide, its superb wool, and its meat, which is very much like beef. It costs nothing to support, because it feeds on the grass that grows in between the moss throughout tens of thousands of square miles of northernmost North America.

MEAT SUPPLY FOR THE FUTURE FROM ALASKA'S EMPTY SPACES

Stefansson urged me to procure a ship, load it with musk-oxen, and carry those musk-oxen over into Alaska and let them feed with the reindeer, because they are not competitors but co-operators, feeding off different things. He emphasized the fact that the musk-ox and the reindeer are not enemies, for they learned to live together long centuries ago; and if we could fill up the empty spaces of Alaska with these two species we would have a supply of meat that would provide for the whole Pacific coast.

OTHER ALASKAN TREASURES

Copper! The second greatest copper mine in the world is in Alaska.

Mount McKinley National Park! The greatest protected area in the world for the mountain sheep and the caribou.

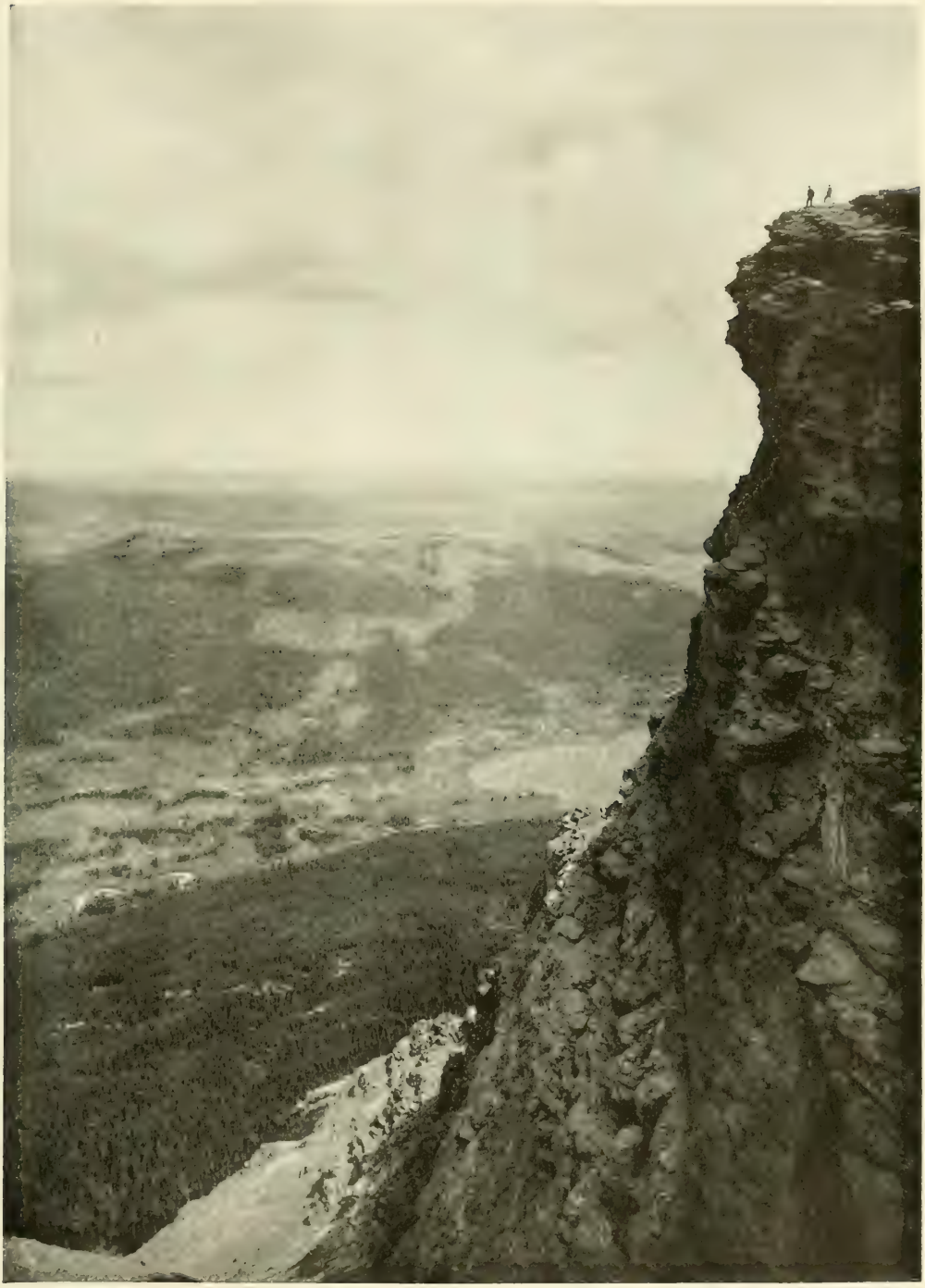
Gold! Once mined abundantly, but gold cannot be mined in Alaska now. Although thousands of miles are underlaid with gold, the mines are closed for a very singular reason. It does not pay to mine gold. Labor is so high, material is so high, that when you get the gold from the ground at the standard price fixed by the Treasury, you do not get your money back. I suppose this is the first time in the history of the world when mines of gold have been closed down because it does not pay to operate them.

As you come down out of Alaska you find the fishing industry, which will be

Photograph by Gilbert Grosvenor

THE OPEN TRAIL IN GLACIER NATIONAL PARK: MONTANA

A transcontinental railway parallels the southern boundary of Glacier and an automobile highway connects the outside world with beautiful McDermott Lake, but the main attractions of this great playground are the trails that lead from one group of comfortable chalets to another, thus opening to the traveler on foot and on horseback unsurpassed views of mountain and waterfall, lake and glacier.



Photograph by Fred H. Kiser

SUMMIT OF APPISTOKI MOUNTAIN, WITH TWO MEDICINE VALLEY 3,000 FEET BELOW, GLACIER NATIONAL PARK: MONTANA

Although this national park still has 60 small glaciers at their painstaking task of sculpturing the mountains, Two Medicine Valley represents the completed product. High precipices and irregular lakes occupying the deeply carved portions of the valley distinguish the impressive landscape.

BLACKFEET INDIAN TEPEES ON THE SHORE OF ST. MARY'S LAKE, WITH RED EAGLE MOUNTAIN LOOMING IN THE BACKGROUND, GLACIER NATIONAL PARK: MONTANA (SEE PAGE 501)

Not many years ago this region was the favorite hunting ground of the Blackfeet tribe. Copper was discovered here in 1890, and there was a great rush of prospectors. Six years later Congress bought the land from the Indians, but as a copper region it proved disappointing. In 1910 it was set aside as a national park. The variety and majesty of its scenery and its ready accessibility, owing to its situation adjacent to one of the great transcontinental railway lines, have resulted in its ever-increasing popularity with the American people

supplemented in time by another great industry, the vegetable-canning industry. I should not be surprised to find the peas of the future raised in that snowbound country and canned there. The finest turnips that I have ever eaten and the largest and crispest celery came from Alaska. And there is a territory of 600,000,000 acres almost untouched that belongs to your Uncle Sam.

THE WONDERFUL STATE OF WASHINGTON

You come on down the coast to the State of Washington. There we have at one point the largest rainfall of any point in the United States—150 inches. And on the other side of the State is or was the great desert of the Columbia basin. Land that I could have bought for $1.25 an acre is today selling for $1,000 an acre. Why? Because we have invested a little money in taking the waters that flowed down from Mount Tacoma (or Mount Rainier) and, turning them upon that land, have planted apples. One of the apples planted here comes from the Hudson River. The people of New York State did not care for and love this fruit as those people did out there. They have taken the Delicious apple as you know it, pruned it, watered it, sorted it, cared for it, until now it makes that land worth $1,500 to $2,000 an acre.

The dominant feature in the landscape in the State of Washington is Mount Rainier. I like the name Tacoma because it is an Indian name. Rainier was the name of an admiral who saw this splendid place. Tacoma was the Indian name and means "The feeding breast"; and when you see the mountain you will realize where the Indians got that name, because from every side come down rivers which make for the strength, the beauty, and the wealth of the country.

Here is one of our great parks; and I have stood therein with the snow of the glacier in one hand, and touched with the other the blossoming wild flowers.

THE STATE'S GREATEST TREASURE

That State is rich in mines, rich in agricultural land, rich in power possibilities. It has hundreds of thousands of acres of land that are practically desert and that can be reclaimed and brought into usefulness by use of the water of the Columbia River.

And yet the most significant thing in that State is the State University. I saw Seattle when it was a frontier town, and there was little thought then of its possessing a great university; but there are 6,000 students in the University of Washington today, and that State is only 30 years old. This fact indicates better than anything else can the trend of American life. America has in her mind the purpose to do things that make for a richer country not only materially but also intellectually.

You come down from Washington to Oregon, with its long line of mountains, its majestic river, its vast forests. There is one outstanding scenic feature of novelty, Crater Lake. The top was blown off a volcano, and in the center of that crater we find the most exquisite bit of water—a thing without parallel in color in this country, perhaps in the world.

And there is abundant land yet to be had "where rolls the Oregon." We have recently brought back to the United States a strip of land ten miles wide and 300 miles long which was granted to the Oregon and California Railroad, and that land has been thrown open to homesteaders.

WHY THERE ARE "CALIFORNIACS"

Go farther south and you come to California. Being a Californian, I must speak with some degree of modesty regarding that State, though that is said not to be characteristic of the Californian.

Let me tell you a story: I went over to Baltimore to speak to a Methodist conference some time ago. I met there a splendid-looking man, with a long, flowing, white beard, and I said to him, "Do you preach in this section of the country?" He said, "Yes, sir; I come from the Eastern Shore of Maryland. Have you ever been on the Eastern Shore?"

I said, "No; I am sorry to say that I have seen every other beauty spot in this country, I believe, but I never have seen that."

"Well," he said to me, "we love that country. I have been preaching there for 66 years. We are a strange people and we have some strange legends, and one of them is that a long, long time ago, when Adam and Eve lived in the Garden of

Photograph by Albert Schlechten

"OLD FAITHFUL" GEYSER, YELLOWSTONE NATIONAL PARK: WYOMING

That dependability in Nature is not without its reward is proved by the love of the farmer for his fertile fields and by the age-old worship of the never-failing sun. In the greatest geyser field in the world, one has won greater honor than the rest. They do not call this one "The Brilliant" or "The Giant," but "Old Faithful." For many years it played with great regularity every seventy minutes, but during the summer of 1915 the interval lengthened to eighty-five minutes, owing, it is supposed, to the smaller snowfall and consequent lessened water supply of the preceding winter.

Photograph from Horace M. Albright

FEEDING TWO DEER IN YELLOWSTONE NATIONAL PARK: WYOMING

Last winter many of the wild animals in America's largest national park suffered severely. Here one of the rangers is feeding two of the shy, graceful deer which, under the protection of the government, have become partly domesticated.

Eden, they fell sick, and the Lord was very much disturbed about them, and he called a council of his angels and wanted to know where they should be taken for a change of air, so that they might improve.

"The Angel Gabriel suggested that they should be taken to the Eastern Shore of Maryland, and the Lord said, 'No, no; that would not be sufficient change!'"

It is somewhat in that same spirit that every Californian speaks of California, and that is the reason why one of us has given the name of Californiacs to all those who are expatriated like myself.

THE RÔLE OF THE PADRES IN DEVELOPING CALIFORNIA

California was peopled by the Indians first and followed by the padres, and it is a strange thing that wherever the Catholic Church has gone in that State you will find a most fertile spot. The rich centers of California are all gathered around those exquisite missions which those beloved fathers taught the Indians to build.

The Mission Fathers brought with them the art of irrigation, which was a new art to this country; and they brought their sprigs of vine and of orange and of fig and laid the foundation for the wondrous productions of that State. So that today you will find from the very northernmost part—from Klamath Lake, on the edge of Oregon—down to the Imperial Valley, in the south, the lands of California watered and made as fertile as the valley of the Nile.

As you journey down the State you see some of those superb things that God has made for the delight of his people—Mount Shasta, the Yosemite Valley—yes, and the great redwood trees, the oldest living things on this or any other continent. They were there, those great sequoias, when Christ came upon earth; they were there when Moses brought down from the mountain the tables of stone—five thousand, six thousand and more years old. And because of commercial reasons—out of the mere desire for railroad ties—people are cutting

© Haynes (St. Paul)

AT THE BUFFALO FARM: YELLOWSTONE NATIONAL PARK: WYOMING

No longer are the western plains crowded with herds of bison, but in the Yellowstone these one-time lords of the prairie have found a sanctuary where they thrive and multiply. Here the visitor finds one of the finest fields for nature study in the world, for wild animals of many species have become accustomed to the presence of friendly men.

ONE OF THE THREE CHIEF ATTRACTIONS OF THE NATURAL BRIDGES NATIONAL MONUMENT: UTAH

This massive span of rock, the Edwin, constructed by Bridge-Builder Nature, stretches 111 feet above the ancient river bed. The extreme width of the archway is 205 feet. The Augusta Sandstone Bridge, near by, has a height of 265 feet and a width of 320, compared with the Natural Bridge of Virginia's height of 215 feet and span of 90 feet.

Photograph by Wiswall Brothers

TAHOSA VALLEY FROM LOOKOUT, ROCKY MOUNTAIN NATIONAL PARK: COLORADO

The region now embraced in this matchless playground and geological wonderland was once a famous hunting ground, and an Englist nobleman tried to buy it some years ago with a view to converting it into a private game preserve; but in 1915 it was created a national park, the thirteenth in America's growing family, which now numbers nineteen

Photograph from Famous Players-Lasky Corporation

THE CLIFF PALACE, MESA VERDE NATIONAL PARK: COLORADO

From this elevated home site the cliff-dwellers looked out across the deep canyon in whose shadowy depths they raised their corn. The group of about 200 rooms is divided into four quarters. Nearly 50,000 acres have been set aside as a national park to preserve the antiquities which remain from an earlier civilization

Photograph by J. Smeaton Chase

"HITTING THE GRIT": A SAND-DUNE PASTIME IN COLORADO

Like the sand seas of the Sahara and the medanos of Peru, which march uphill at the rate of a mile and a quarter a century, the dunes of the Colorado Desert provide a weirdly impressive landscape. Here, however, the tobogganning possibilities of the topography appeal to youth more strongly than does scenic charm.

down those trees and have been doing so for years until now we have organized what we call a Save-the-Redwoods League, and we hope to raise enough money to save a strip of redwood along the great highway that leads from San Francisco up to the Oregon border, probably, when it is developed, the finest single bit of coast scenery in the United States, perhaps anywhere, bordered on both sides by these magnificent trees.

The destruction of these forest giants is a cruel thing. I cannot speak of it without some degree of emotion. Commercialism has its benefits, but commercialism can be a curse when it destroys things of beauty and things that cannot be replaced. We have saved Yosemite Valley. We have a park called the Sequoia National Park, in which the greatest redwood trees are preserved, and we want to expand that park and give it a new name—make it larger and call it Roosevelt Park.

THE MOST PRODUCTIVE LAND IN AMERICA

You go down farther to the edge of Mexico and you will find the Imperial Valley, which was once an inland sea and came very near being an inland sea again ten years ago, when the waters of the Colorado broke through the protecting barriers and flowed down into the valley. Here are 300,000 acres of desert land that now is the most productive single piece of land in this country, because the waters of the Colorado, rising in Wyoming and Utah and Colorado, have been brought and turned on to that land.

Across the way, in Arizona, is another irrigation project—Yuma. Yuma has been noted for but one thing, its heat and the piercing quality of its sand, which drives into your face; but Yuma is being turned now into one great garden.

The government recently offered for sale some of the public lands on what is called the Yuma Mesa, and men offered $250 and $260 an acre for that land, barren as it is, but with the water right promised for the future.

A CAMPAIGNER IN THE WEST

I knew Vice-President Stevenson somewhat, and talking one day to a cousin, Judge Ewing, about the success that Stevenson had made as a campaigner in the West, how cleverly he adapted himself to every situation, Ewing told me this story:

The Vice-President and Judge Ewing had started out from Illinois on a car attached to the rear end of a train, and when they reached Missouri Mr. Stevenson came to the back platform, met the multitude, and said; "My friends, since coming into Missouri and looking into your most intelligent faces and seeing the prosperity that you enjoy, I have determined that if I ever change my place of residence I shall adopt yours."

Ewing continued: "We went over into Kansas, and there the Vice-President said: 'Since coming into Kansas and looking at your fields of waving grain and the happiness that is depicted in your faces, I have said to myself, "If I ever change my place of residence I will adopt yours" '; and he came into Colorado, and it was the same story there; and then into New Mexico, and at last to Yuma, Arizona; and in Yuma there was nothing to be seen in the landscape except cactus and sand, and there was nobody to meet us but a group of Indians, and all they wore was a blanket thrown over their shoulders, as they huddled in the shade of the depot, and it was 130 degrees in the shade. I thought that the old man would fail there, but he came right to the front, looked down at these Indians with their blankets, and said: 'My friends, since coming to Yuma, and looking upon you, I have decided that if I ever change my style of dress I will adopt yours.' "

And yet that spot—Yuma, the hot, and Yuma, the home of the desert Indians—is a very successful, prosperous business center, surrounded by land that grows oranges and lemons and, to my taste, the best grapefruit grown in the United States.

THE APACHE INDIAN AS A CITIZEN

Up above there we have the Salt River project, known because of the Roosevelt Dam; and that dam was largely built by the Apache Indians. The best Indian (and there are lots of them in all this country of which I am talking) is the Indian that fought us the hardest. He had gimp, he had stuff, he had the conception of himself which did not permit him to be conquered, even by the white

man; but when he had to yield to the inevitable he turned to work, and work has become his salvation.

There is no better illustration in the world of the fact that work is our salvation than the Indian. Where he has abundance of money, where he is cared for as in an orphan asylum, where he is paternalized, where he is treated, as many would have him treated, as a baby in arms, he does not grow, he does not flourish, he does not become a man. But where he is made, like the New England fathers, to struggle for his own living, and finds that he cannot live unless he is forced to struggle, he comes through and makes a man of himself.

THE CHANGE THAT HAS COME OVER IDAHO

Now we start at the northern boundary again, at Idaho. There is a State which a few years ago was thought to be an almost worthless piece of land, good for forests and with a few minerals. I was on a piece of land along the Snake River, in Idaho, two years ago which raised 575 bushels of potatoes to the acre.

We have there the highest dam in the world, the Arrow Rock Dam, built by our own people. The government is now projecting an enterprise to water, perhaps, several hundred thousand acres of Idaho land. The undertaking will involve the moving of a city, the town of American Falls, taking that town up on wheels and carrying it a mile or two back, so that we can flood the land where it now stands.

Seven years ago I visited the Minidoka project, in that State, and found the people discontented. Today they are, I suppose, among the happiest farmers and the most contented people in our country. Here I saw a town where there never had been a fire lighted, houses with fireplaces and with chimneys, and some houses without fireplaces and without chimneys. No fires were necessary because at the dam above the town the water had been stored to irrigate the land, and at the dam electric power was generated for use as heat, light, and for cooking. The women churned with electricity and the sewing-machines were run with electricity. I suppose they had a sort of paddling machine for the naughty children that they ran by electricity. It was an electric city.

THE ELECTRIC AGE ON THE FARM

And that is not an impossibility in any section of our country. One of the things that women can do (and women do love a precise and definite job) is to try to make the life of the woman on the farm more happy. There is no one group of people deserving more sympathy, more of support, more positive aid, than the woman who lives on the isolated farm; and for her electricity, if it can be brought to her house, is invaluable.

For the woman farmer in Maryland, Virginia, and Pennsylvania electricity is just as necessary and just as possible. Why can't we take our coal at the mouth of the mine or down in the mine, turn it into electricity, and send that power by wire over every farm of the country? We do it where we have water power, and you can generate electricity with natural gas and with coal.

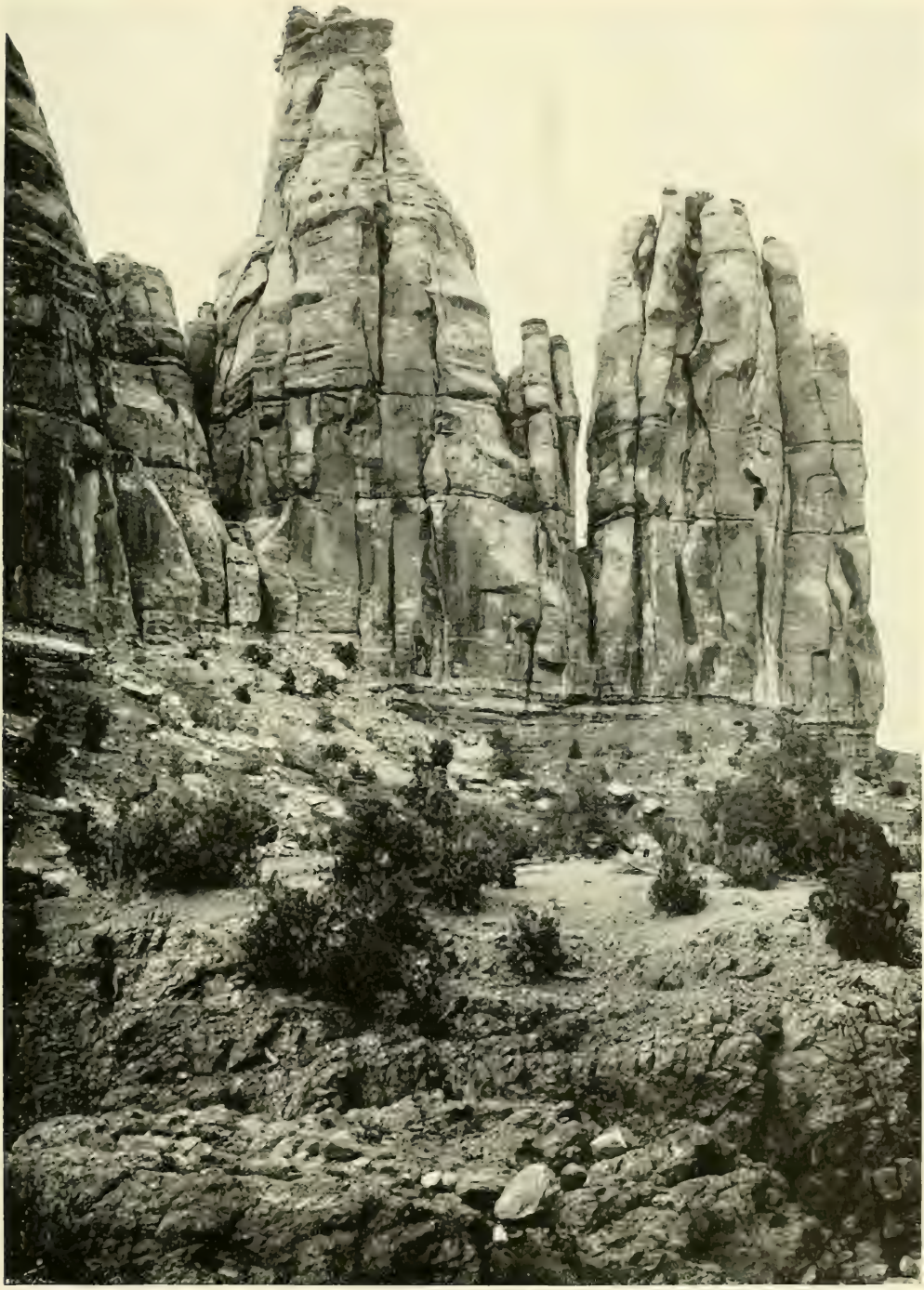
We are a wasteful people, for we do not know the possibilities in our resources; but some time the engineering mind will get to work upon such practical problems as this, and then life will become less complex and the woman on the farm will have more time to herself to think of the things that she ought to have some chance to think of.

Idaho is a rich State and is growing rapidly. It has a bed of phosphates, practically inexhaustible, to fertilize that whole Western country; and it has forests, mines, a fine State university, and an excellent school system.

WHAT THE MORMONS HAVE DONE FOR UTAH

Crossing the border you come down into Utah.

Never speak disrespectfully of the Mormon Church. It has as law-abiding, steady, hard-working, kindly a group of people in Utah as will be found anywhere this round globe over. Brigham Young may not have been a prophet of Almighty God, but he worked a miracle when he crossed from the Missouri River over that desert, leading his band of a few hundred followers with their push-carts, going out into that unknown waste,



Photograph by George L. Beam

COLORADO NATIONAL MONUMENT: WESTERN COLORADO

"The Court group" is one of many highly colored, fantastic formations in this reservation. As a standard for comparison, note the minute figure of the man who is standing halfway between the camera and the rock, shown at right of center.

A ZIGZAG MOUNTAIN ROAD NEAR DENVER, COLORADO

and turned the land that lies around Salt Lake City into a garden.

I brought from Egypt several years ago the greatest irrigation expert in the world, perhaps, the man who built the Assuan Dam upon the Nile—Sir William Willcocks, the man who claims to have discovered where the Garden of Eden was located, at the junction of the Tigris and Euphrates rivers—and I sent him to look over the irrigation enterprises of the United States, and he said: "Nowhere else have I seen people who understand so wisely how to apply water to land as around Salt Lake City."

Utah has wonderful beauty in it as well as great stretches of desert that are to be reclaimed. We have just discovered a new beauty spot there, Bryce Canyon.

A PROSPECT FOR THE FUTURE

When the King of Belgium was here I gave him a picture of a new beauty spot in the United States that we had found within a canyon. Just think of a land in which after 100 years or more of occupation men can go out and discover a great canyon filled with wonderful stalagmites, great pillars of rock which rise up hundreds of feet from the bottom of the

Photograph by Kolb Brothers

MOONEY FALLS, A CATARACT WHOSE NAME PERPETUATES THE MEMORY OF A DARING MINER, WHO LOST HIS LIFE WHILE BEING LOWERED TO THE BOTTOM OF THE PRECIPICE, 180 FEET

The Indians have given the name of Havasu to this canyon, and they call themselves the Havasupai—the People of the Blue Water. The Havasu is one of the most beautiful of the lateral canyons of the Grand Canyon of the Colorado.

canyon in colors like those of pastel. I hope we shall soon turn this into another of our national parks.

Just below this spot is the Colorado River, where we already have the Grand Canyon National Park. And some day some one will put a stick of dynamite into the bank of the Colorado River and blow it out and throw a dam across and store those waters, and then we shall have power enough to run the railroads of that section and power enough to lift the waters of that river up on to the mesa lands and turn that desert into orchard.

Those are the things that fill your mind when you are in that Western country: A mountain in Utah being cut down at the rate of 50,000 tons a day, and every ton of it yielding copper; going out in the

Photograph by Kolb Brothers

GRAND CANYON, LOOKING SOUTH FROM THE KAIBAB PLATEAU, WITH THE ZOROASTER AND BRAHMIN TEMPLES ON THE LEFT

Pantheism ought to be natural in Grand Canyon, for not only has Nature furnished the most awe-inspiring panorama that the titanic forces of geography have ever unrolled for the eye of man, but a score of edifices carved by the patient hand of Time suggest the religious temples of various races reaching from the plateau of Iran to the valley of the Ganges.

desert in southern Utah and sticking down a probe into the earth and striking oil flowing at the rate of a thousand barrels a day!

And better things than oil or fruit or copper come from those Western lands. Take that land over in Oregon, to which I have referred. In that valley was raised a boy who walked from the Willamette Valley down to Stanford University that he might have an education as a mining engineer—Mr. Herbert Hoover. Those are the great, great things that we are producing. There is hardly a State that is not known by some one individual's name; and there are some of them that are already known by the names of a dozen men who have given distinction to the States from which they come.

THE NOBLEST VIEW IN AMERICA

Now let us go up north again, into Montana. You are at Glacier Park. I have not seen all of the grand places of the world; but if I were to be asked what one thing in nature had most impressed me I would not say the Canyon of the Yellowstone, beautiful and rich in color as it is, or the Grand Canyon of the Colorado, overwhelming in majesty and inspiring as it is; but I would say that when you stand at the edge of Saint Mary's Lake and look across and up to the two mountains—one named by the Indians "Going to the Sun" and the other "Almost a Dog"—you would find probably the one thing on the North American Continent that would inspire you most and make you feel most properly humble.

Glacier Park, with glaciers and lakes, alongside of the Blackfeet Indians, and down south of them the Sun River irrigation project.

Six years ago I was petitioned by a great body of people on that project to release them from their obligation to take water. I went out to see them. We held a mass meeting of all the people on the project, and all begged that they might be allowed to continue their life as farmers by the dry-farming method. They said there was no danger of drouth coming; that they were doing splendidly, and that they did not wish to be obligated to pay $60 or $70 an acre for water rights.

I protested, I urged, I begged them to look further ahead; I held out to them the prospect of sure crops, larger crops; but my voice was not listened to.

The only person on my side was a girl, a girl, I suppose, 19 or 20 years of age, who had been a school teacher in the East. She saw what that country could be with irrigation and what it would be without irrigation. She made a capital speech, but she did not succeed; so I said, "We will abandon this project because you wish it."

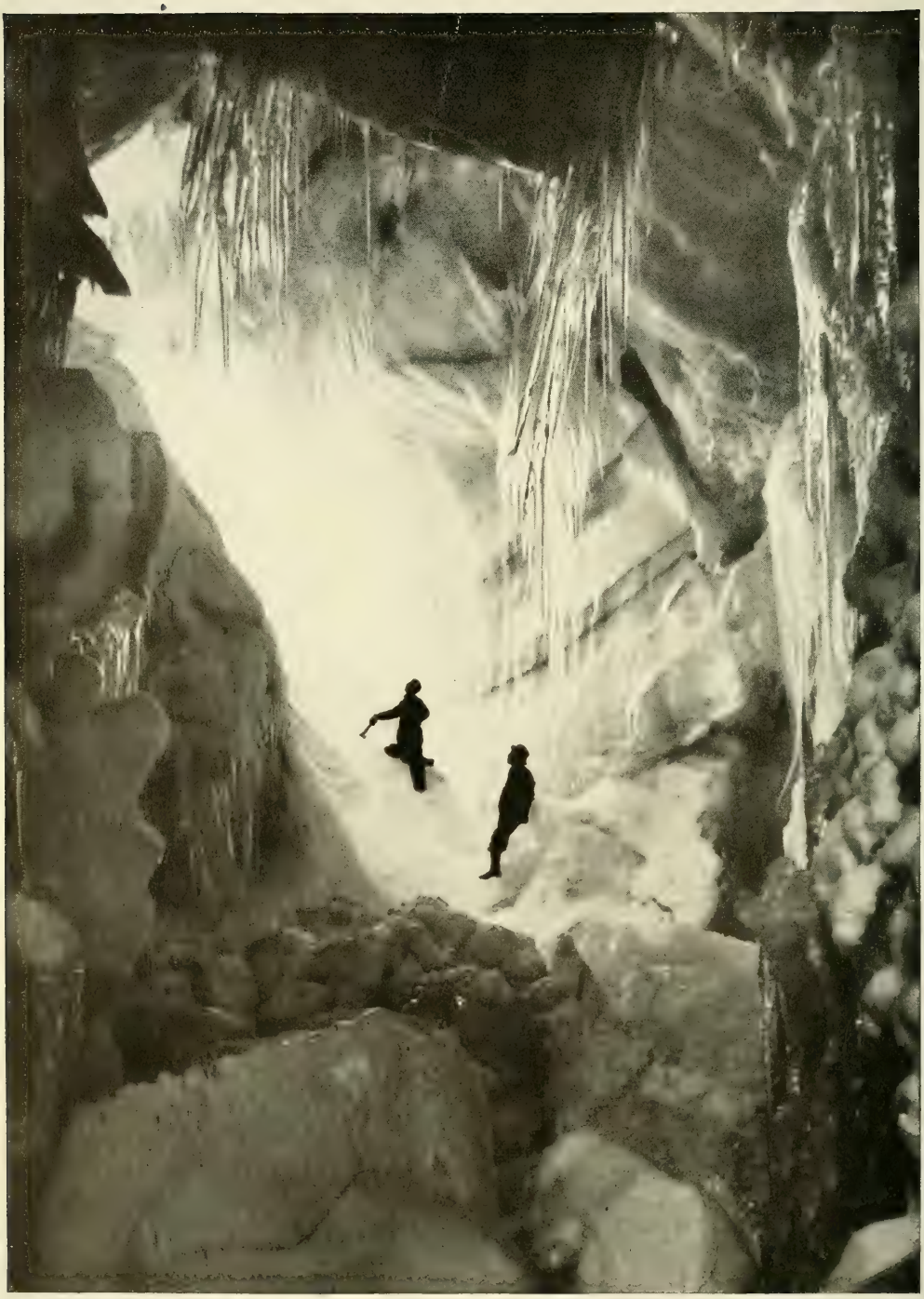
A few weeks before I relinquished the duties of Secretary of the Interior I received a petition, signed by every man that was left on that project, asking that we again take it up and develop irrigation upon it, thus testifying that the girl was the one true prophet of the whole group.

Come down out of Montana, with its beauties and its Indians and mines, into Wyoming — irrigation there, Indians there, mines there, oil there—and into Colorado. In Colorado we have a park where you can stand at one spot and see twelve mountains, each one 12,000 feet high. I want to see that park extended along the east side of the Rocky Mountains, so that it will include everything from the Rocky Mountain Park down to Pike's Peak. Already one hundred and fifty thousand people visit this section with their automobiles every year—car licenses from New York and Maine, from Manila and Honolulu.

HE TREATED HIS TREES LIKE CHILDREN

In Colorado, too, we have irrigation projects. I was on one of these projects some years ago, and I met a man who had gone there to combat tuberculosis. He had left Illinois, where he had been a railroad man. He had a little money, bought about five acres of land, and put it into peaches. He told me that the year before he had made $2,500 off those five acres of peaches.

I asked him the secret of his success, and he said, "Because I love every tree. Each morning when I get up I go out among the trees and treat them as if they were my children. I look at them, I pat them; I look at the soil; I look up at the leaves to see if any leaf has turned yellow, and if there is I discover the cause of it. I love each of those trees, and the



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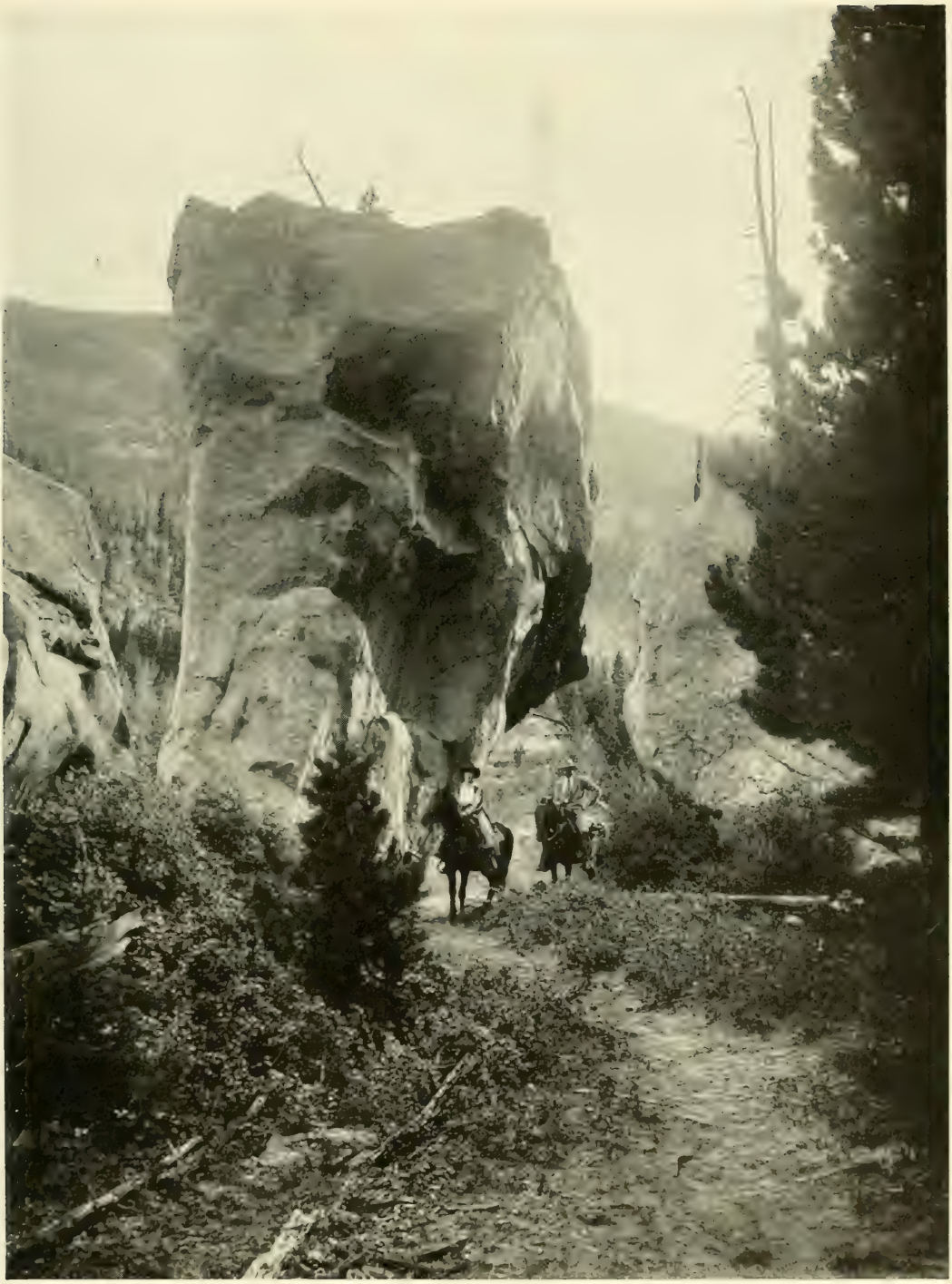
INTERIOR OF HALLETT GLACIER, ROCKY MOUNTAIN NATIONAL PARK: COLORADO

Not only is Rocky Mountain Park famous for its beautiful glaciers—Hallett, Tyndall, Andrews, and Sprague's—but more especially for its glacial records of millenniums past. Here in truth "the mountains, rock-ribbed and ancient as the sun," reveal to the eye of inquisitive man the story of the world in its making.



BALANCED ROCK ON THE TRAIL TO FERN AND ODESSA LAKES: COLORADO

Everywhere in the great West one encounters the unexpected. Many are the balanced rocks weighing hundreds of tons, yet so delicately poised that it would seem a mere gust of wind could unbalance them. But neither storm nor stress, through countless centuries, has been able to shake them from their apparently insecure foundations.

Photograph from National Park Service

SLAIN DEER ON A STATION PLATFORM NEAR YELLOWSTONE NATIONAL PARK

A national park is a modern counterpart for the ancient city of refuge, and within its boundaries game is safe from the hunter; but the heavy snows sometimes cause famine, and the wild animals leave the park in search of food only to be shot down by those who are waiting for them beyond the limits of the preserve.

result is that they give something back to me and I am an independent man."

There is a secret in that too. It has its application pretty much through life.

AN ANSWER TO STRANGE PHILOSOPHIES

Colorado, one-third of it forest; and yet when the King of the Belgians was here the other month there was a dinner given to him in one of our fine houses, and he was served upon gold plates that were literally dug out of the soil of the State by a man who was a miner, the husband of the woman in whose house this dinner was given.

If all Europe knew that a man by will and skill and hard work could dig into the soil of the United States and bring out the gold, bring out that which makes men rich, there would not be much feeling there that any of these strange philosophies that are being preached would make great progress in America.

I could go on and on and take each individual State and show how intimately it touches the Department of Interior. Take Illinois. You would not suppose that there was much in Illinois that might interest this Department, which is primarily a department of development. But outside of Chicago there is an exquisite place, called "The Dunes," down by the lakeside—a lovely place made by the shifting sands—that some day we ought to have for a park.

A PLEA FOR THE COUNTRY SCHOOL

Just outside of Chicago, also, there is a model country school. Do you know that we do not give the children in the country districts a fair chance? I wanted several years ago to get Congress to appropriate $300,000 that I might get a representative teacher from each district in the United States to spend a month at that school in Illinois, where they could find out how country children should be taught, how each boy and each girl in the school could be made to articulate with father and mother on the farm. I could not get the money. But some day we will dignify the country school and still more dignify the country school teacher.

Talk about being underpaid and not being able to live, not being treated with respect and having no dignity given to you! No one has as justifiable a com-

A FOREST GHOST ON FLATTOP MOUNTAIN, ROCKY MOUNTAIN NATIONAL PARK: COLORADO

Wind, snow, and flying particles of rock have reduced this old spruce tree to a skeleton of its former self.

plaint as the school teacher of the United States. In that one State two or three years ago the ordinary farm laborer was paid more than the school teacher.

WHAT DO WE DO FOR THE TEACHER?

If your Americanism is founded upon intelligence (and it must be if it is going to live), you must have somebody who can bring out of the young what is in them. It is not a question of pouring; it is a question of drawing. You cannot expect that from a girl who gets $40 a month. Moreover, you have got to treat people with respect and with dignity if you are going to get the best out of them.

What recognition do we give to the teacher? What social status does she have? We talk of Americanism, and there is the person who is at the very heart and center of Americanism. Upon her depends our future. She can be made the greatest instrumentality for building up the right spirit within the boy and girl in America—the greatest of all instrumentalities for Americanization.

NEW YORK CITY CHILDREN LEARNING TO SWIM IN ONE OF THE CRIBS PROVIDED IN PALISADES INTERSTATE PARK

While possessing no national park within its confines, the State of New York has in the Palisades Reservation one of the most picturesque playgrounds and natural retreats on the continent. We need many more such parks in our Eastern States.

I had rather have the school teacher than to have all the newspapers and moving pictures and organizations and congresses and all else combined, because she can sow the seed in ground that is fallow. And what status do we give to her? With what dignity do we treat her? What deference do we pay to her? Socially, where is she?

If you love this country, if you believe that you are a good American, see that the teacher gets an adequate salary, see that she gets proper recognition! For all of life is not money. The intangible things are the things for which most people fight and that are of most value. And there is no better illustration of that than the city of Washington, to which people are drawn largely because of those intangible things, not the least of which is our vanity, our love of distinction.

OUR INDIAN SCHOOLS

I sometimes think that our Indian schools in places are better than some of our schools nearer home. We teach the Indian boy to raise four kinds of grain upon a plot of ground, to shoe a horse, to build a shack, and he comes out of that school not only knowing a little reading, writing, and arithmetic, but knowing how to make his living. He is not called away and told to fight for himself without any tools, without a sword in his hand.

We have Indian schools in which we teach the girls how to care for themselves and others. We have little cottages. We put two girls in a cottage. Those girls each month must produce a hat and a dress and do all their own cooking; and they must cultivate a garden patch and learn how to care for a sick baby and a sick woman.

In Oklahoma we have a group of Indians who are the richest people in all this world, with an income of $20,000 a year per family. They are not the very best Indians that we have. I don't like to say that; but it is true, because they have too much money and they don't have to work.

But down here in North Carolina we have a group of Cherokees for whom nothing has ever been done, and I hope nothing will ever be done for them. There has not been an illegitimate birth for forty years in that reservation. It has fine upstanding, self-respecting, well educated farmers and herders.

Way down in Florida are the Seminoles, who fought us 100 years ago. Today they raise cattle and are contented. I was offered a million acres of land by the State of Florida if I would drain it, and I wanted it badly, because I wanted it for the soldier boys. I had the thought that when this war was over we could make great use of those lands. And we could, if we had acted in time and had a bit of foresight; if there was not so much politics in this world, and it did not take so many men so much time to realize what ought to be done.

THE CHALLENGE TO WOMAN

We are not going to be happy cluttered together in houses banked up against each other in cities. That is not the normal, natural life for us. We are not to have cities made of apartments and boarding-houses and hotels and produce the good, husky Americanism that has fought our wars and made this country and developed those lands that I have been talking about. The thing that is big within us is the creative instinct, and the challenge that is up to woman is to stimulate and develop that in man.

Every man feels the desire to get down into the soil and wrestle with it and make it yield to him. It is a part of the instinct that God implanted at the time when He ousted man from the luxury of the Garden of Eden; and he has been marching round the globe making that conquest ever since.

Now, because of the lure of pleasure, because of the moving-picture shows, and because of the desire to get close together, man is deserting the farm. When I was born, 70 per cent of our people lived in the country; now not more than 50.

THE PLAN FOR THE BOYS FROM THE OTHER SIDE

If that movement goes on, we are not going to have the America that we have had—that has been vibrant, fibrous, strong, self-dependent, resourceful.

So I wanted those boys when they came back from the other side to have a

A SCENE IN THE PROPOSED VICTORY PARK, ADIRONDACK MOUNTAINS: NEW YORK

Only two of the national parks antedate our Centennial and only three others are thirty years old. The national park is the democratic equivalent for the vast estates of the nobility of Europe; yet no noble has such playgrounds. The first parks were centered around more or less inaccessible natural wonders, but a movement is on foot to provide the thickly populated parts of America with playgrounds which, while lacking some of the phenomenal features of Yellowstone or Yosemite, still will meet with the universal demand for lovely scenes and places of wholesome outdoor recreation.

A CAMPING PARTY IN PALISADES INTERSTATE PARK: NEW YORK AND NEW JERSEY

There is no joy limit to the ride along the Palisades of the Hudson River and the speed of a smile a mile is here being largely exceeded. This beautiful playground comprises many thousands of acres along the west bank of the Hudson, in the States of New York and New Jersey, including what is known as Harriman Park, in Rockland County.

piece of land allotted to each of them, where they could live in communities to which they could bring their brides—land that would have a little cottage on it and be fenced and broken, so that the boy could go upon it at once and make his living; borrow a few hundred dollars from the government and put stock on the land; having a modern house and a community center around which this colony would gather.

I wanted one of those communities in every State, so that all might see what an ideal farm life should be, for I thought that the gospel would spread.

We could have had this. There is abundant vacant land, land that can be had for almost nothing. Between the National Capital and the Gulf of Mexico there are 32,000,000 acres of unused lands. We could support the entire United States, if need be, on that body of land.

I wanted these boys to be given that

chance; but it would have cost some money. That is the hard thing to get, especially if it involves vision. But we must come to it; we must come to it if we are going to have the kind of men in the future that we have had in the past.

We must keep the boy in love with the soil. He must feel as the French peasant felt who was fighting because that soil that he loved was his. There is something in the old story of Antæus. You reach down and touch the soil and you get strength from it; you do not get it from asphalt streets. One hundred and fifty thousand boys have written asking that they might have a chance at such a farm, and we cannot give it to them.

POWER! POWER! POWER!

Power! Power! We must have more power! I want all our streams that have possibilities for power, from the James all up to the Saint Lawrence River, connected, the power developed in them, and then a great channel, a stream of power, circulated through those States. It can be done; it will be done some day.

I make the appeal to women that they fire the men with the ambition to make this country what it can be. We have done gloriously, but we must not stand still. The way to stand off Bolshevism is not to talk about it; it is to do things which show that in this nation there is hope; that we have possibilities; that this land is the best of all lands.

Why? Because it is filled with a people who have imagination and willingness to work. We must stimulate those imaginations and keep at work. We can stand off ideas of any kind, because we can meet them with the one solid argument that Lincoln was so fond of; he always spoke of the argument of facts.

These things that I have enumerated are in America. And if a man has his best chance here, then that man will be proud of the traditions and the institutions and the character of the people that have made this country. That is true Americanism.

TO KNOW AMERICA IS TO LOVE IT

Then, too, we must show to the people around us that the principles that have guided our fathers, the love of liberty and the love of right and the sense of mercy and kindliness, are things that a nation may express occasionally, but that every one of us must express constantly.

You cannot take the man from the Balkans and the woman from Norway and interpret America to them in strict terms of abstract law, or in terms of mountains of copper, or of miles of railroads. You must interpret America to them in terms of American life—the beauty of American life, its dignity, the generosity of our natures, our willingness to be fair, our desire to help, our knightlike qualities.

To know America is to love it. For it is a thing of life; it is growing, struggling, climbing, stumbling. It is thinking through its problems, groping through them, living through them. Out of its wealth in things of the earth and its greater wealth in things of the spirit it is making a new society, different from any that is or that has been.

We do not see what is going on. We see but a phase, the tiniest segment of a great circle.

Under liberty and order men are stimulated to their best, challenged to create. The inhibitions of long-settled static societies are lifted and the possible man is having his day.

MEN DREAMING DREAMS

So everywhere throughout this land, away off in those remoter sections which I have mentioned, as well as nearer by, men are dreaming dreams. Some write those dreams on paper, and some write them on the mountain side in orchards, or within the mountains in mining shafts, or in the tall buildings of the cities, or in safe docks for ships.

Everywhere this new people in this new land is doing something that is a service. Boys in the sage-brush colleges are writing poems, men are planning books or novel mechanical devices. Girls are preparing themselves for the study of the sciences. Painters and sculptors and chemists are proving themselves.

They have the world to draw on; all its richness is theirs by inheritance—the color and warmth of the Mediterranean peoples and the sterner, colder, more steadfast stuff of the North.

This is to be a new picture in the world gallery.

© F. P. Clatworthy

THE ROOF OF THE CONTINENT IN ROCKY MOUNTAIN NATIONAL PARK

Astride the Continental Divide, Rocky Mountain National Park not only contains a noble company of great peaks rising from flower-clad valleys, but through the variety and legibility of its glacial records, it forms the people's Rosetta Stone of glacial geology and reveals to the nature student intelligible evidence concerning the remote past.

THE SQUARE CROWNED HEAD OF LONG'S PEAK FROM THE FROST-CARVED FLANK OF FLATTOP

Beloved monarch of all he surveys, this king of Colorado summits rises almost in the center of the four hundred square miles of mountain grandeur constituting Rocky Mountain National Park. Here glaciers whose irresistible power is combined with a laggard advance are building up moraines and illustrating to contemporary man the forces that shaped our continent in the past.

© Asahel Curtis

"THE MOUNTAIN THAT WAS GOD": MOUNT RAINIER

This mountain of Indian mythology constitutes the Kohinoor of Mount Rainier National Park, fifty-seven miles from Tacoma. With an unconscious insight into the service rendered by mountain peaks, the red men of the Northwest called this great snow-peak the "Fountain-breast of Milk-white Waters."

© Asahel Curtis

MOUNT RAINIER, THE MAJESTIC

Once a lofty beacon, lighted by the volcanic fires, the violent respiration of the mountain titan added height to his stature and breadth to his shoulders. Mount Rainier has now donned an ice mantle, miles in length, through which his rugged frame obtrudes. Twenty-eight glaciers form "His Majesty's" ermine cloak.

© A. C. Pillsbury

THE ROCK PORTALS OF YOSEMITE VALLEY

On the left rises the sheer precipice of El Capitan, more than two-thirds of a mile in height, whose grandeur seems more impressive from the upper side. Across the valley, Cathedral Rocks cut the blue above the spot where the wind-blown lace of Bridalveil Falls is draped from plateau to valley in snowy purity, enhanced by spray clouds of iridescent beauty.

© Fred H. Kiser

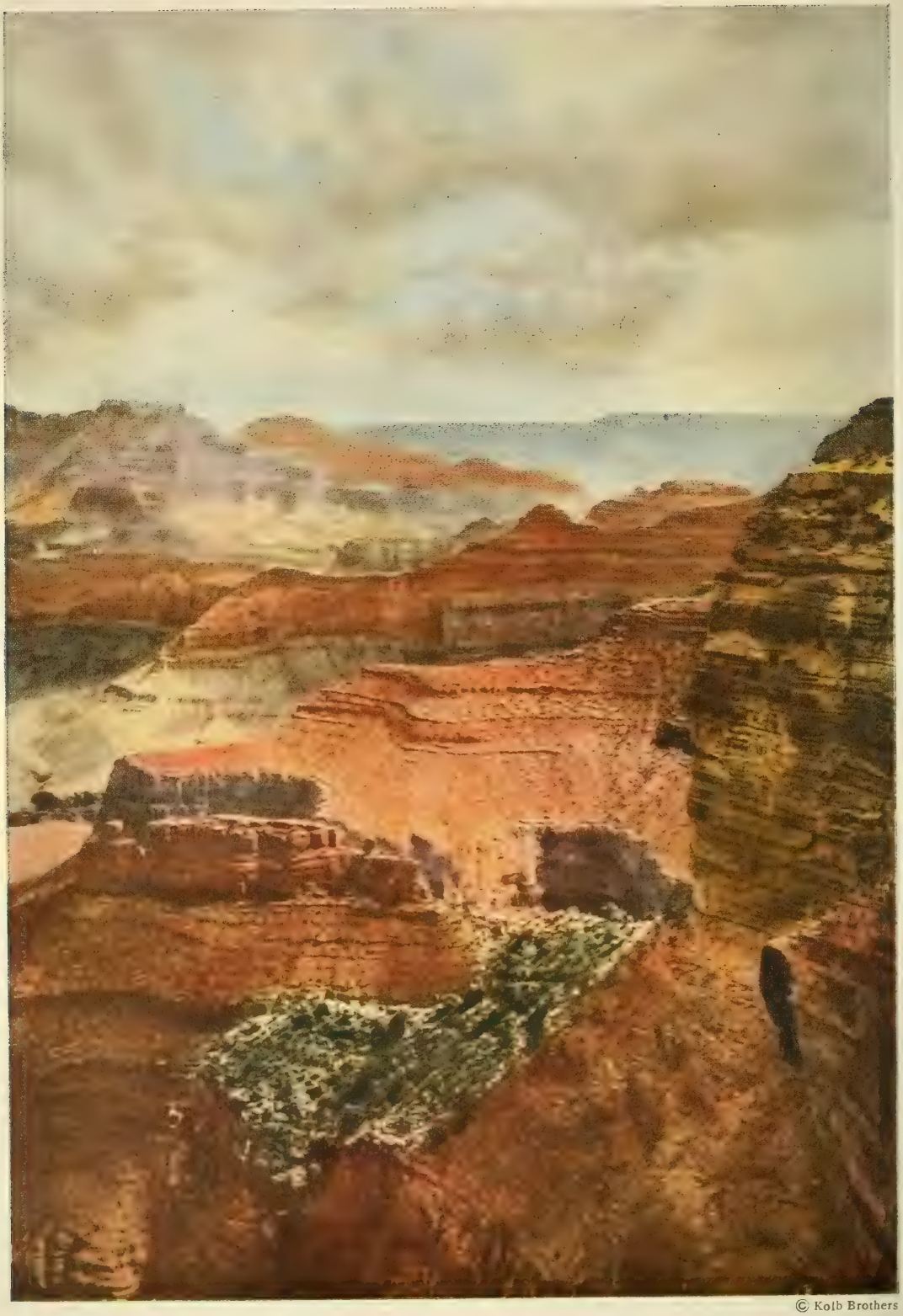
THE GLORIOUS GRAVE OF A FALLEN MONARCH: CRATER LAKE NATIONAL PARK

Kings of nature, like their human counterparts, sometimes pass away in a spectacular fashion. Mount Katmai blew off its head, but its mighty mass still dominates the view. Mount Mazama, wasted away by internal disorders, collapsed into the seething mass above which it once raised its proud head. There was a reaction and the internal forces tried to raise another monarch. But the coup failed and tiny Wizard Island, almost drowned in blue spring water of surprising clearness, stands as the impotent heir of a blustering sire.

© Asahel Curtis

THE NIAGARA OF THE NORTHWEST

Not far from Seattle, Washington, Snoqualmie Falls, more than half again as high as Niagara, furnish the rapidly growing city with immense power. Beauty and modernity co-operate rather than compete along the Pacific Coast and the cities have unsurpassed mountain panoramas.



© Kolb Brothers

THE CYCLOPEAN CANYON OF THE COLORADO: LOOKING EAST FROM HOPI POINT

Tinted with the camouflage coloring of the Supreme Artist, "The Battleship" occupies the lower foreground. Beyond rise the heights that have been named the "Vishnu Temple" and "Wotan's Throne." High above them, on the precipice to the right, the ceremonial fires flare forth upon the memorial altar erected in honor of Major J. W. Powell, who first traversed the Grand Canyon by water.

SAVING THE REDWOODS

By Madison Grant

Mr. Grant's recital of the inroads which are being made upon some of the oldest and most magnificent forests of the nation will be read with keen interest by every member of the National Geographic Society, which was largely responsible for rescuing the finest group of Big Trees (Sequoia gigantea, or Washingtoniana) of the Sequoia National Park from the fate which now threatens the Redwoods of northern California. The members of the National Geographic Society will recall that at a time when, through a failure of Congress to appropriate a sum sufficient to prevent the Big Trees of the Giant Forest from falling into the hands of private lumber interests, the Society supplemented Congress' appropriation by a subscription of $20,000 in order that these age-old monarchs might be preserved in perpetuity (see "Our Big Trees Saved" in The Geographic *for January, 1917).*

THE eastern tourist visiting California feels that he has explored the State when he has crossed the Sierra and the central valley, with perhaps a side trip to Lake Tahoe and to the Yosemite Canyon, with its Mariposa grove of big trees, and has completed a leisurely trip down the southern coast.

After a journey of this character, which is all that is accomplished by nine out of ten visitors, he carries away an impression of a golden brown, semiarid countryside, waterless stream beds, endless fruit orchards, entire absence of turf and grass, abundant flowers, a rainless sky, and a pitiless sunlight.

There is, however, another and different California on the coast from San Francisco north to the Oregon line. This region is heavily wooded, with running streams and abundant moisture, fogs taking the place of rainfall during the summer months.

Much of the immediate coast is an old Pleistocene strand, elevated about 1,000 feet above the sea and cut through at various points by rivers and streams. The new boulevard runs along this elevated beach-line for many miles, and when completed will be one of the finest motor highways in the world.

With high mountains to the east, the traveler looks out over the vast expanse of the Pacific toward the setting sun.

It is along this northwestern coast that the great redwoods of California are found, and it is here that the photographs accompanying this article were taken.

The impending destruction of these forests is the most serious question confronting California in the effort for the preservation of some portion of her vast inheritance. It has been stated officially that all of the old stand of forests in the United States will be cut off within the next sixty years, but this period will be materially shortened by the new methods of logging.

Before describing these groves, it may be well to say a few words about the genus *Sequoia,* as there is much confusion regarding the big trees of the Sierra and the redwoods of the coast.

SEQUOIAS WERE FLOURISHING WHEN DINOSAURS ROAMED THE EARTH

The genus *Sequoia,* to which the two surviving species of the great trees of California belong, stands widely separated from other living trees. Together with closely related groups, it once spread over the entire Northern Hemisphere, and fossil remains of Sequoia and kindred genera have been found in Europe, Spitzbergen, Siberia, Alaska, Canada, and Greenland.

Changes in climate and other causes have led to their gradual extinction, until the sole survivors of the genus are confined to California—one to high altitudes in the Sierra Mountains and the other to the western slope of the Coast Range.

Fossil leaves and cones of genera closely related to Sequoia occur in the rocks of the Jurassic and of the Trias, and the members of the genus Sequoia were common and characteristic trees in California throughout the Cretaceous.

To give some idea of what this bald statement means, these trees, virtually

Photograph from Charles Willis Ward

LOOKING UP THE GREAT KLAMATH RIVER FROM THE GREAT DIVIDE AT THE WATER GAP: CALIFORNIA

The trees shown in this illustration represent more than one billion feet of lumber—an irresistible temptation to commerce if title to the forest is not obtained by the National Government as a reservation in perpetuity for all the people of America.

in their present form, flourished in California before the mammals developed from their humble, insectivorous ancestors in the Mesozoic, and while the dinosaurs* were the most advanced form of land animals.

The mountains upon which these trees now stand contain fossil records of early Sequoia-like trees, proving that this group abounded before the rocks that constitute the present Sierra and Coast Ranges were laid down in shallow seas, to be upheaved later and eroded into their present shapes. In the base of Mount Shasta and under its lava flows, the ancient rocks are marked with imprints of their leaves and cones. Such antiquity is to be measured not by hundreds of thousands, but by millions of years.

THE BIG TREES OCCUR IN ISOLATED GROVES

While the duration of the family, of the genus and even the existing species, or species so closely allied as to be almost indistinguishable, extends through such an immense portion of the earth's history, the life of the living trees is correspondingly great.

The Sequoia is not only the oldest living thing on earth, but it is the tallest tree in the Western Hemisphere, and we have no reason, so far as our paleobotanical studies have gone, to believe that there ever existed on earth either individual trees or forests that surpassed in size, in girth, in height, or in grandeur the Sequoias of California. And these are the trees that are being cut for grape stakes, for railroad ties, and for shingles.

While the purpose of this article is to deal with the redwoods of the coast rather than the big trees of the Sierra, both of the genus *Sequoia,* a description of the redwood should be preceded by a few words on the big tree.

The big trees, *Sequoia gigantea,* are found on the western slope of the Sierra Nevadas, in California, at an altitude of from five to eight thousand feet above the sea, with a north and south range of about 250 miles. They do not constitute a solid stand, but occur in more or less isolated groves, and growing with them are other huge trees, chiefly white fir, incense cedar, sugar and yellow pine.

These groves are about thirty-two in number and are much scattered and isolated in the northern part of their range, while in the south they are larger and closer together. This distribution shows that the big tree is on the decline, the various groves having long since lost touch with each other, while in the north the reproduction is very poor. They all grow in spots sheltered by surrounding forests, and the slopes of the Sierra are more or less windless, but now that the white man has taken the land they would soon be destroyed for their valuable lumber, unless artificially protected in national parks.

They have suffered throughout the ages from ground fires. Their extraordinarily thick bark, which is from one-half to two feet through, is a great protection, and although its heart has been burned out, a tree lives on so long as this bark and its underlying cambium layer can reach the earth.

If protected by human care, the big tree has remarkable recuperative power, and many specimens in the Giant Forest of the Sequoia National Park show an accelerated growth, owing to their immunity from fire even for a few decades.

These trees are from five to twenty-five feet in diameter at shoulder height above the ground, and in the Giant Forest alone there are said to be 5,000 trees of more than ten feet in diameter.

The height varies from 150 to much more than 225 feet, and as they are without taproots, they stand absolutely straight, often without branches from the ground to a height of 175 feet.

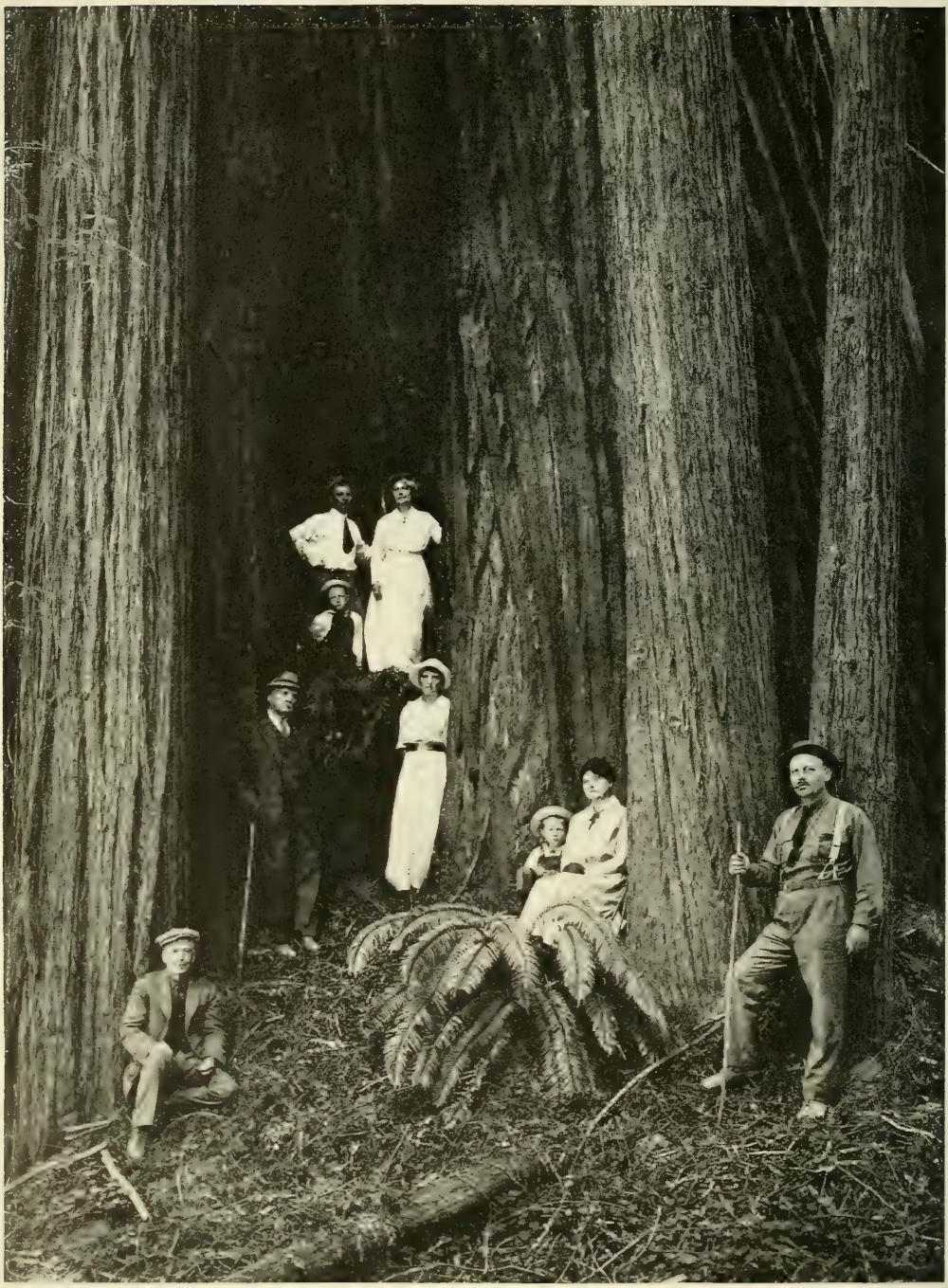
WHY THE TREES' CROWNS ARE DEAD

The crown usually is dead; not blasted by lightning, as has been often asserted, but because ancient fires have eaten in at the base, so that the flow of sap to the top has been checked.

When connection with the ground and the life-giving water supply has been strongly re-established, growth takes place from the topmost uninjured branches and forms a new, but false, crown.

It is estimated that if these trees had escaped upsetting by the wind, and had

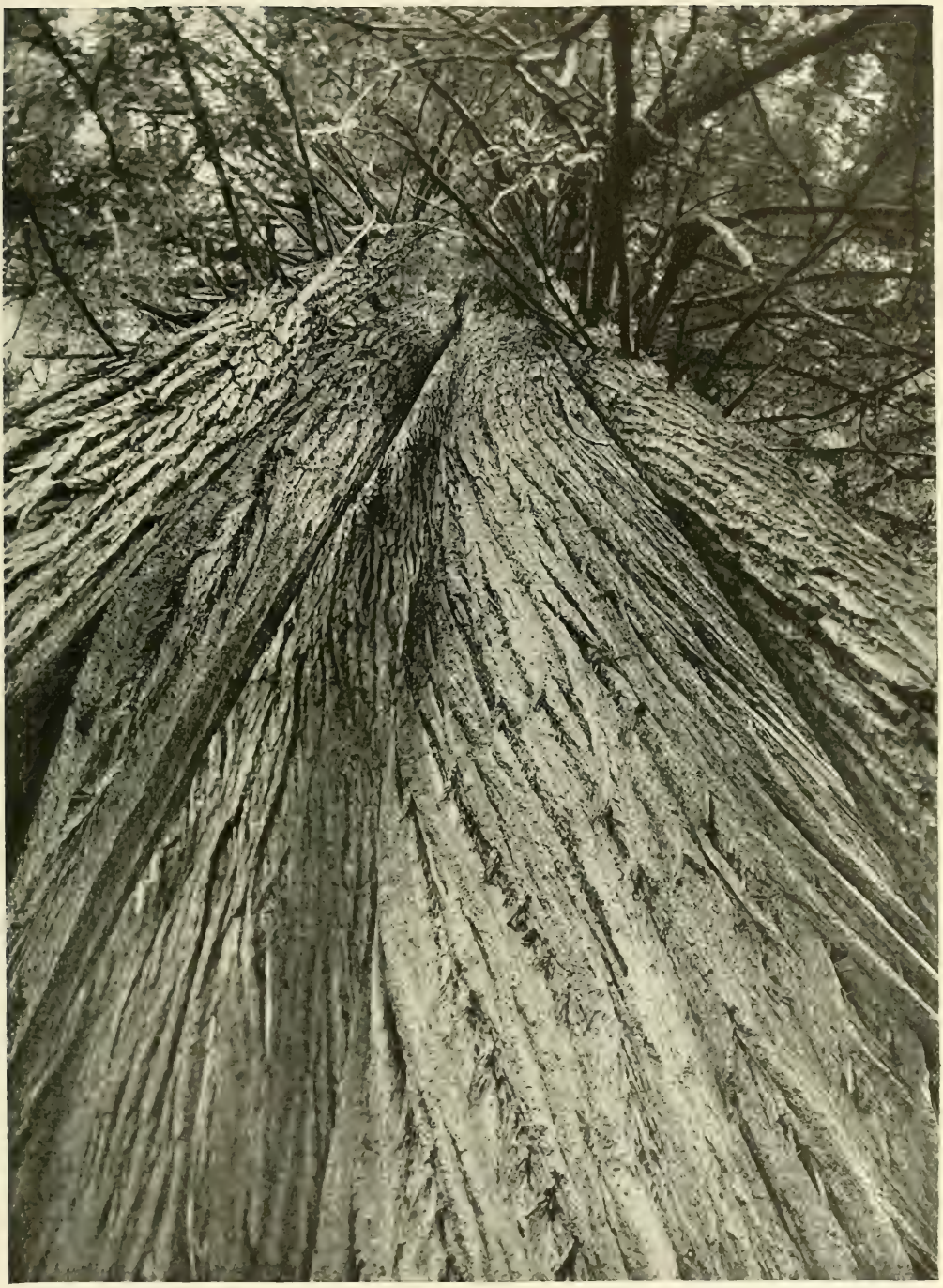
* See "Hunting Big Game of Other Days," by Barnum Brown, in the NATIONAL GEOGRAPHIC MAGAZINE for May, 1919.



Photograph from Charles Willis Ward

ONE CLUMP OF REDWOODS CONTAINING 250,000 FEET OF LUMBER; THIS GROUP OF TREES IS GRAFTED TOGETHER AT THE TOP (SEE ILLUSTRATION, PAGE 523)

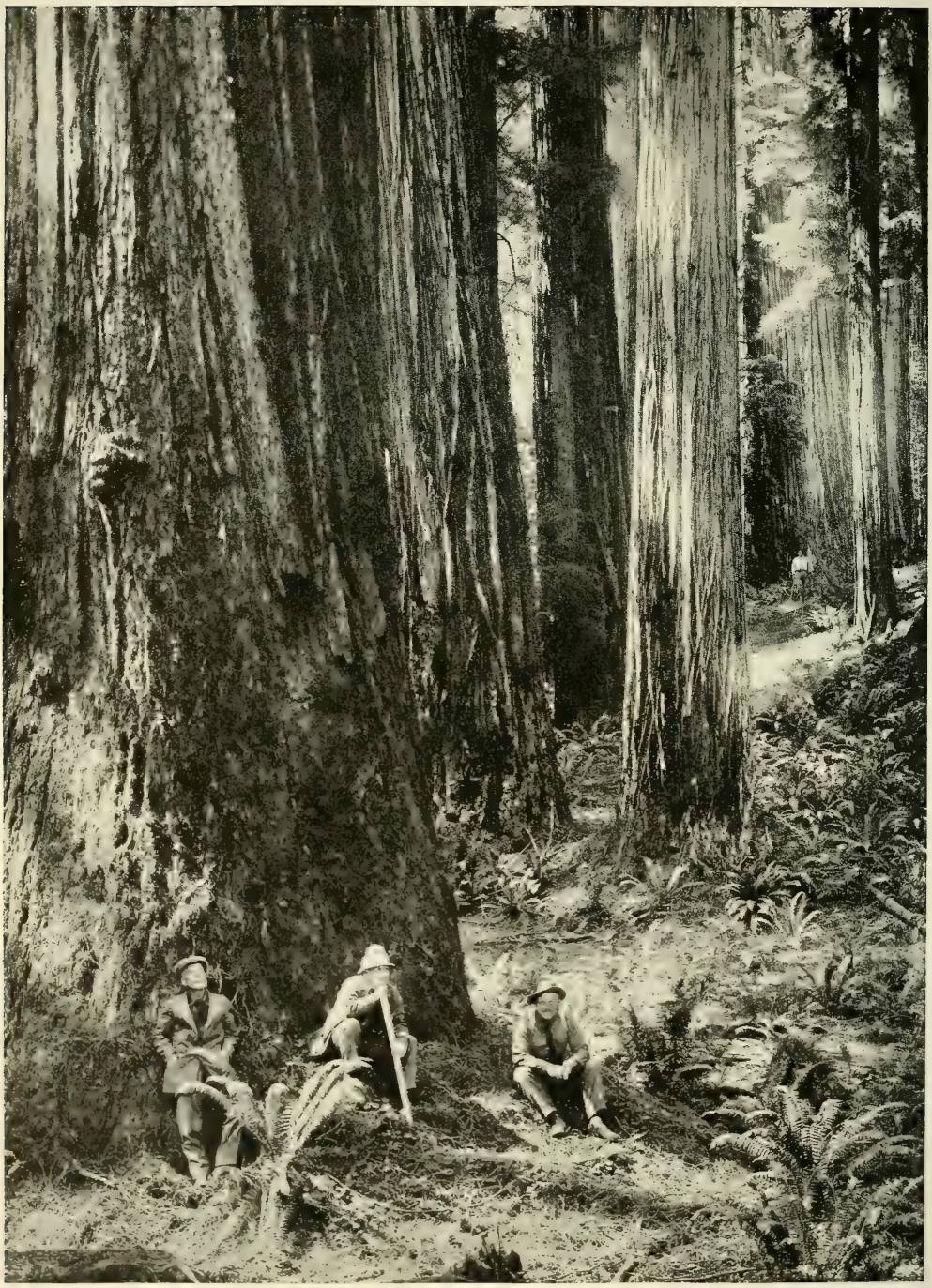
The age of the redwood is about half that of the Sierra Big Tree, and the life of the mature specimens ranges from 500 to 1,300 years. Some of the Big Tree specimens when felled have been found to be more than 3,250 years old, and the General Sherman Tree undoubtedly exceeds these in antiquity.



Photograph from Charles Willis Ward

A SKYWARD VIEW OF THE CLUMP OF TREES, GRAFTED TOGETHER AT THE TOP, SHOWN IN THE ILLUSTRATION ON PRECEDING PAGE

The redwood has an unusually thick bark, but this serves as only partial protection from forest fires. In lumbering operations it sometimes happens that a loss of 30 per cent in timber results from the fires started to destroy the debris—brush, shattered branches, and fallen trunks.



Photograph from Charles Willis Ward

NO HEAVIER STANDS OF REDWOOD THAN SHOWN IN THIS ILLUSTRATION CAN BE FOUND IN THE REDWOOD BELT

The tree in the left foreground is 18 feet in diameter and contains 100,000 feet of merchantable lumber. These trees if preserved will soon produce more profit each year for the State than can be obtained temporarily by their destruction, and they will prove a source of increasing wealth to the State with each passing generation.

been allowed to grow entirely free from fire throughout their age-long existence, and had carried their proportionate growth (calculated from the tapering of the trunk) to their uttermost limits, they would be 600 feet high.

This is mere speculation, as is the theoretical age of some of the more ancient trees. The known age of trees which have been cut is from 1,100 to 3,250 years, but there is little doubt that this long period is much exceeded in such cases as the General Sherman tree or the Grizzly Giant. The life of these giants can be computed only by comparison with the measured trunks of lumbered trees, the actual age of which has been ascertained from the rings of growth.

There is always a factor of uncertainty in the size of trees, depending on their rate of growth and supply of water. In exposed positions, with poor water and soil, development may be greatly retarded, and a tree may be very ancient although relatively small in size. On the other hand, a favorable location, such as a pocket in the rock or access to underlying water, might greatly accelerate the growth of a tree within the same grove.

REDWOODS OF THE COAST

The redwood of the coast, *Sequoia sempervirens*—the immortal Sequoia—far from being a battered remnant, like its cousin of the Sierra, whose shattered ranks remind one of massive Roman ruins, is a beautiful, cheerful, and indomitable tree. Burned and hacked and butchered, it sprouts up again with a vitality truly amazing.

It is this marvelous capacity for new growth from trunk or from root saplings which is, perhaps, the most interesting character of the redwood in contrast with the big tree, which has no such means of regeneration and must depend on its cones for reproduction.

All the redwood forests have been more or less injured by fire, sometimes of ancient origin, but more often deliberately started by the lumbermen to clear away the slash, and it is a wonderful sight to see a charred trunk throw out a spray of new growth twenty or thirty feet above the ground, or a new tree standing on top of an ancient bole and sending its roots, like tentacles, down into the ground around the mother stump. Other trees stand athwart the fallen bodies of their parents and continually readjust their root systems to the decaying trunks beneath it.

The vitality of the second growth throws up a circular ring of new and beautiful redwoods around the parent stump, and these little trees come up again and again if cut. If, however, they are buried several times in succession, this capacity of shoot reproduction appears to be lost, and there are cases, notably about fifteen miles north of Arcata, in Humboldt County, where the highway passes through three or four miles of very large and thickly set burned stumps that show little or no signs of reforestation, proving that there are conditions where human greed and human carelessness make it impossible for even the redwood to survive.

REDWOODS ARE YOUNGSTERS FROM 500 TO 1,300 YEARS OLD

The age of the redwood is about half that of the Sierra big tree, and the life of a mature redwood runs from 500 to 1,300 years, in many cases probably more.

The diameter of the larger redwoods is sixteen feet and more and the height runs from 100 to 340 feet. Thus, while its diameter is less, its height is far greater than its cousin, the big tree, with the result and effect of a graceful beauty rather than impressive solidity. It is probable that trees will be found which will exceed this maximum altitude, and it is quite possible that an ultimate height of 350 feet may be recorded. One would anticipate the discovery of this tallest tree on earth either in Bull Creek Flat or along Redwood Creek.

Of course, in discussing the present redwoods, one must always bear in mind that many of the finest groves have fallen to the axe, judging from the silent records of gigantic stumps along the Eel River, especially at Sonoma Flat, only recently destroyed.

It is probable that the existing groves, with few exceptions, such as Bull Creek Flat, do not represent the finest groves of redwoods of fifty years ago. How needless all this sacrifice of Humboldt redwoods has been may be measured by

© Freeman Art Company

ONE OF THE MOST CONSPICUOUS FEATURES OF THE REDWOOD GROVES IS THE PROFUSION OF FERNS CARPETING THE GROUND BENEATH THE FOREST MONARCHS

Some thirty species of fern have been found in the forests of Del Norte and Humboldt counties, California.

the fact that few, if any, of the lumber companies have proved profitable investments, if their failure to pay dividends is a test of their commercial success.

THE REDWOOD RANGE IS 450 MILES LONG

The original range of the redwoods extended from Monterey north along the California coast to a point a few miles over the Oregon line, embracing an area with a length of about 450 miles and a width not exceeding 40 miles. The narrowness of this range seems to be determined by the fog which sweeps in from the Pacific, and the writer has seen the edge of the fog-bank clinging closely to the inland limit of the redwood belt.

Many natives believe that the redwoods attract fog, but of course it is the moisture of the fog deposited on the tops of the trees that determines their inland distribution. These forests are sometimes so wet that the dripping from the high crowns is like a thin rain, and at Redwood Creek in summer it is hard oftentimes to tell whether it is raining or not, so saturated with moisture are the foliage and the trunks when the fog darkens the forest.

In the southern and larger half of their range, the redwoods are somewhat broken up in more or less isolated groves, and the axe of the lumberman has now separated these groves still more widely. In the north there is an almost continuous series of solid stands of redwoods, constituting the most magnificent forests in the world, not even excepting the great Douglas firs and pines that adjoin them in Oregon.

The redwoods in the south seem to show a marked variation from those of the north, being generally redder in color, and their growth in rings or circles is much more frequent than in the groves of Humboldt and Del Norte counties.

THE VALUE OF A LIVING TREE FAR EXCEEDS THE VALUE OF ITS TIMBER

South of San Francisco the redwoods are now found chiefly in the Big Basin, which has been wisely made into a State park, and in the famous Santa Cruz grove. Intermediate spots along the Coast Range, notably at La Honda, are interesting chiefly as showing the pathetic solicitude with which the owners of surviving trees care for the battered remnants amid the charred stumps of former giants.

Here at least the owners have learned that *the value of a living tree at a public resort or along a highway far exceeds the value of its lumber.* All these southern groves are mere reminders of the forests that are gone, but the surviving trees will be carefully protected.

North of San Francisco the Muir Woods, on the slopes of Mount Tamalpais, are easily accessible and show something of the forest grandeur formerly found in the region of the Golden Gate. The preservation of this grove is entirely due to the wise munificence of Mr. William Kent, who presented it to the nation.

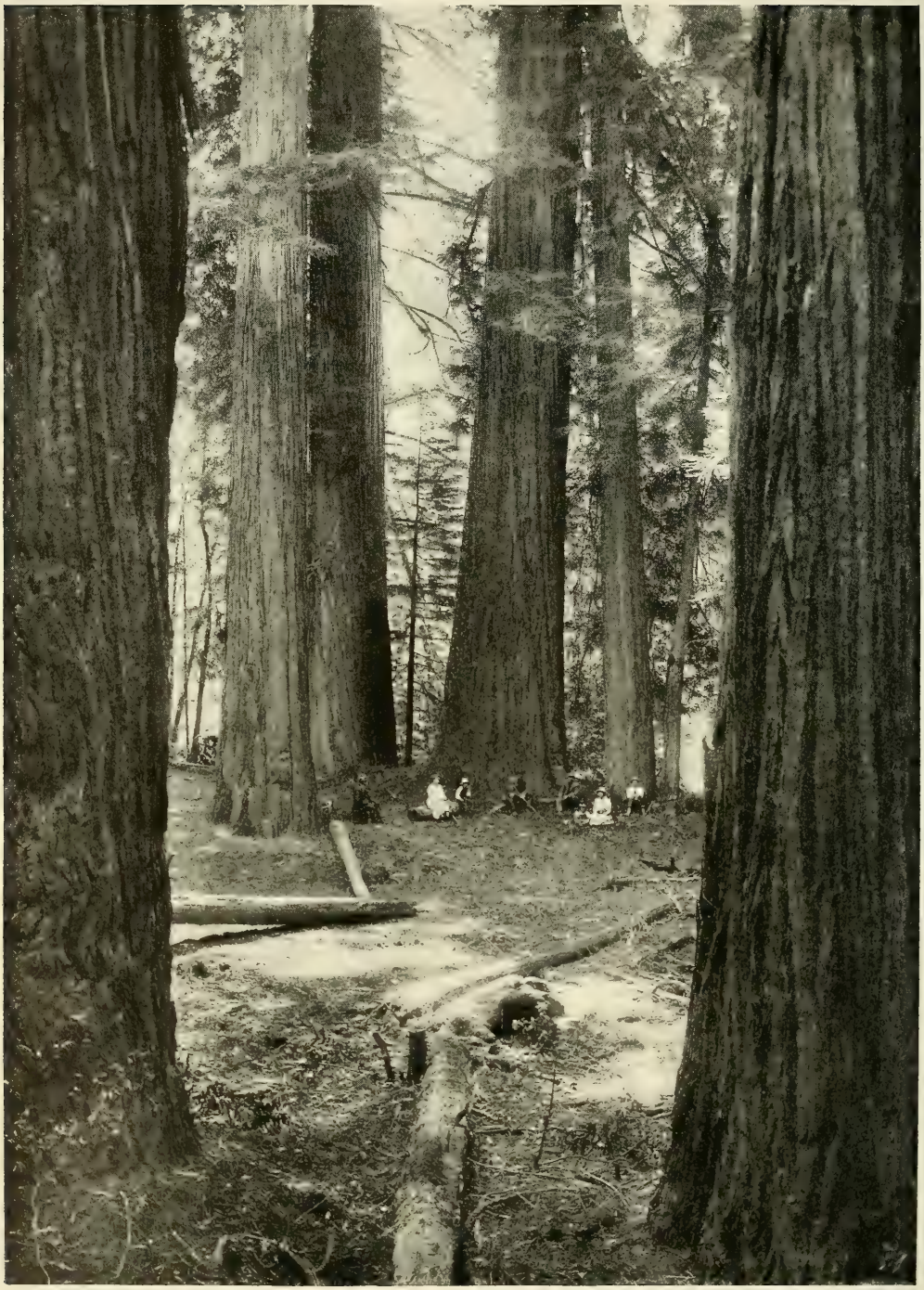
To the north, Sonoma County has purchased for public use the Armstrong Grove, and Mendocino County probably will be impelled to buy the Montgomery Grove. These last trees are situated near the highway to the north of Ukiah and will be the first grove visited by the northbound tourist. If they are purchased by the town or county, Ukiah will become the entrance to the Redwood Park series, and, like Merced, at the entrance to the Yosemite Valley, will derive a large revenue from motor tourists.

After leaving Mendocino County one enters the great groves of Humboldt and Del Norte counties. Here are solid stands of redwoods, and the observer finds it difficult to distinguish between one grove and the next.

Four great forests stand out prominently: They are (1st) the groves along the South Fork of the Eel River and the west bank of the main Eel, culminating in the Bull Creek Flat and the Dyerville Flat; (2d) the immense Redwood Creek grove; (3d) the Klamath River groves, and (4th) the Smith River groves at Mills Creek, in Del Norte County. Each has its peculiar beauty, and it is difficult to choose among them, but it is the trees of Humboldt County, along the South Fork of the Eel River, that at the present moment are most in peril.

ITS VIRTUES IMPERIL THE REDWOOD

The groves along the South Fork of the Eel River are traversed by the State highway, now in the process of construction. The building of this highway made the timber accessible, and the immediate



Photograph from Charles Willis Ward

A CAMPING SITE AMONG THE KLAMATH RIVER REDWOODS: CALIFORNIA

"The inhabitants of Del Norte and Humboldt counties have scarcely awakened to the possibilities of fabulous wealth in their redwoods as an attraction for visitors."

result was the establishment of small lumber camps that are destroying the trees along its edge. Not only are the trees along the road cut down, but the highway itself in many cases has been injured.

These great trees, with their hundreds of feet of clear timber, have, among other valuable qualities, the unfortunate characteristic of easy cleavage or splitting, and so they are in special demand for railroad ties, for shakes or shingles, and for grape stakes. These superb trees are sacrificed to supply the stakes to support vines because of the practically indestructible character of the wood, which will stand in the ground almost indefinitely without rotting.

THE CALIFORNIA STATE HIGHWAY RUNS THROUGH THE REDWOOD DISTRICT

In going to the redwood country from San Francisco, the first important group of trees encountered is the Montgomery grove, which lies a few miles west of the highway north of Ukiah, but about fifty miles north of Willits the redwoods begin to appear along the highway in small and scattered groups.

The beauty of the roadway could be greatly enhanced by saving these small groves and scattered trees. Their ultimate preservation, however, will depend entirely on the ability of the California Highway Commission to secure a right of way of sufficient width. This has not been done as yet, and farther north, in an effort to avoid expense, the Commission actually purchased a right of way subject to the condition that the owners should remove the timber from it. In other words, a highway was planned through the redwoods to carry visitors to see the trees, and then arrangements were made to have the timber removed. This action was largely taken owing to the widespread, but mistaken, belief that it is impossible to save a strip of timber if the protecting trees on either side are removed. However, California is awakening to the necessity of employing landscape engineers, who will prevent all unnecessary vandalism.

The first important redwood groves are at Hicks' Camp and about twelve miles south of Garberville, at the Stern's Camp grove, the latter comprising some ten acres on a fine level bottom about 300 yards wide. At this point one is forced to recognize the fact that any State park in connection with the highway must include the entire erosion valley of the South Fork of the Eel from crest to crest. The skyline, with its superb trees, is as essential as the bottom flat and much more important than the intermediate area.

The river valley is narrow—in fact, little more than a wide gorge with a level bottom—and the timber on the slopes has less commercial value than that upon the flat. If the timber along the highway is to be preserved, a relatively small amount of additional cost would protect the entire valley.

At Red Mountain there is a fine grove of redwoods, and to the north of that the first cutting was made in 1919. From this point on it becomes evident that the right of way, 100 yards wide, acquired by the California Highway Commission, is not only insufficient, but has actually served to invite logging operations.

The contour of the South Fork of the Eel is such that the highway, with a strip of timber on each side, can be preserved easily without danger of destruction from winds, if due consideration is given to the topography of the ground.

THE WORK OF CENTURIES DESTROYED FOR GRAPE STAKES

It is scarcely necessary to dwell on the need to put an end to the destruction of the oldest and tallest trees on earth. The cutting of a Sequoia for grape stakes or railroad ties (and an eighteen-foot tree along the new State highway was cut a few months ago for that purpose) is like breaking up one's grandfather's clock for kindling to save the trouble of splitting logs at the woodpile, or lighting one's pipe with a Greek manuscript to save the trouble of reaching for the matches.

After the fall of the Roman Empire the priceless works of classic art were "needed" for lime, and statues by Phidias and Praxiteles were slaked down for this purpose; but the men who did it are today rightly regarded as "vandals and barbarians."

Photograph from Charles Willis Ward

WHEREVER THE REDWOOD IS FOUND AT ITS BEST ONE MAY BE SURE OF A DAILY FOG BATH

This photograph shows the sunbeams breaking through the fog as it begins to lift and dissolve. This usually occurs about 9 or 10 o'clock each day during the summer season. Sometimes the forests are so wet that the dripping of water from the high crowns is like a thin rain.

North of Garberville there was much lumbering for railroad ties and grape stakes during the summer of 1919. The cutting was in every case done along the east bank of the South Fork of the Eel River and on the very edge of the highway, and while the devastation was appalling, the damage, if stopped now, can ultimately be minimized.

Farther north the cutting begins to appear at scattered points, but one of the finest groves, a tract of 700 acres belonging to the Hammond Lumber Company, has been left untouched.

A little farther north there is a fine stand of timber owned by the University of Minnesota, and it is to be hoped that this educational institution will coöperate in preserving these trees. From here on there has been much destruction at various points along the road.

After these scenes of devastation and threats of worse, the traveler reaches Bull Creek Flat, perhaps the finest forest in the world. Bull Creek enters the South Fork of the Eel just above Dyerville, and here is a magnificent stand of trees, some 10,000 acres in extent.

If all the forested area needed in connection with the State highway be taken from the upper reaches of the South Fork down to the mouth of Bull Creek, the reservation will contain about 10,000 acres. Bull Creek Flat, with the grove opposite, at Dyerville, will add 10,000 acres, making a total of from 20,000 to 25,000 acres, the minimum for a State park, which in point of fact should be larger and extend northward along the west bank of the main Eel River.

Bull Creek Flat belongs to the Pacific Lumber Company, except two sections in the upper part, which are the property of the Metropolitan Lumber Company. The officials of both these companies have expressed their sympathy with the park project, so far as it relates to Bull Creek Flat. This tract is said to contain one enormous tree, possibly the largest redwood and the tallest tree in the world.

STATE AND NATION MUST BUY BACK THEIR GIFTS

The fundamental tragedy of the whole redwood situation lies in the fact that the great trees are nearly all in the hands of private owners, who cannot reasonably be expected to sacrifice their holdings for public benefit. The State and nation, having given away these lands in the past, must now buy back at least a large portion of them.

On the east bank of the Eel River, for many miles below the forks, there are very few redwoods within sight of the highway except at Fortuna, where 2,300 acres of fine trees have been preserved temporarily and are known as the Carson Woods. This grove is a mile or so east of the highway and should be preserved as a local park.

SPROUTING SAPLINGS HAVE BEEN DESTROYED

Along the lower stretches of the Eel River below Scotia a lumber company is said to have checked reforestation by cutting, during successive years, the sprouting saplings which bravely tried to lift their heads around the old stumps. This was done under the impression that the land could be made available for pasturage. It has proved a failure, and the only result has been to destroy in many places the chance of the forest recovering.

Below the forks, on the left bank, there is a magnificent stand of trees, extending from the water's edge to the crest of the main slope, nearly all of which belongs to the Pacific Lumber Company. This area is some 20,000 acres in extent, and the highway runs through it. It should be preserved, although the cost would be great because of the size of the tract and the fine quality and thickness of the timber. Below this forest the timber on both sides of the river has been almost entirely destroyed.

At Orick, on the Big Lagoon, the highway passes through the lower end of the Redwood Creek grove, one of the very best stands of redwood in Humboldt County, approximately 50,000 acres in extent. The redwoods are largely mixed with spruce and the ground is carpeted with ferns of great abundance and variety. This stand is as yet untouched and should be saved for a national park, because the timber, being inaccessible, can be acquired at a relatively small cost.

One of the most conspicuous features of these redwood forests, especially in Del Norte County and the northern portions of Humboldt, is the profusion of

Photograph from Charles Willis Ward

A BEAUTIFUL CAMPING GROUND

There are hundreds of beautiful camping grounds in the timbered regions of the California coast. The owner of this tract has cleared off a number of spots and put them in shape for the use of visitors. June, July, August, September, and the greater part of October are splendid months for camping. The Interstate highway passes along this tract about two miles to the westward.

ferns, of which there are said to be some thirty species.

The protection of the California redwoods is now the subject of anxious solicitude on the part of many citizens, but the practical means of achieving this result are in the hands of the Redwoods League. There are two distinct movements on foot. First and of instant need are the efforts made by Humboldt County and by the Redwoods League to stop the cutting along the highway on the South Fork of the Eel River.

OPTIONS PURCHASED BY TWO LOVERS OF THE REDWOODS

This has been substantially accomplished, and since August, 1919, all the cutting has been stopped by the purchase of the land on which lumbering operations were here carried on. This was made possible through the munificence of Mr. Stephen T. Mather and Mr. William Kent, each of whom donated $30,000 to be used in the purchase of options on the threatened areas.

These options have since been taken up by the Supervisors of Humboldt County, a body of men having rare foresight. Humboldt County expects to provide a bond issue on a large scale, which will secure the preservation of the groves most in danger, but the bulk of the money needed must be provided by the State of California. The necessary bond issue will shortly be brought before the people. It has been sponsored by the Governor and has the active support of the most influential men in the State.

In addition to this, the Redwoods League has succeeded in enlisting the support of many public-spirited lumbermen and owners of timber, who propose to donate at least a portion of their holdings for park purposes, especially along the highway.

The extent of this redwoods park has been definitely determined as the entire valley of the South Fork of the Eel River from the point where the redwoods begin down to and including Bull Creek Flat and Dyerville Flat. If, in addition, funds can be provided to purchase any or all of the 20,000 acres of redwoods on the left bank of the main Eel farther down stream, a superb reserve would be established.

The Eel River redwoods constitute the most immediate problem, but there is also a very definitely formulated plan to provide a National Redwoods Park. A national park requires a large area, with sufficient isolation and compactness to admit of proper administration. There are three such areas available: 1st, the grove along Redwood Creek, of about 50,000 acres in extent and peculiarly adapted for a national park; 2d, the groves along the Klamath River, as yet untouched and of great beauty; 3d, the Smith River groves, in Del Norte County. A complete survey, such as is now being undertaken by the Redwoods League, will be necessary to determine the relative suitability of these three groves for a national park.

THE REDWOODS LEAGUE

The "Save the Redwoods League" was formally organized in San Francisco in July, 1919.

The league is under the executive control of Dr. John C. Merriam, of the University of California, Berkeley, Calif., and its purposes are:

(1) To purchase redwood groves by private subscriptions and by county bond issues.

(2) To secure a State bond issue to buy the finest redwood groves along State highways.

(3) To establish, through Federal aid, a National Redwoods Park.

(4) To obtain, through State and county aid, the protection of timber along the scenic highways now in course of construction throughout California.

(5) To encourage the State to purchase cut-over redwood areas for reforestation by natural means or by replanting where repeated fires have made sprout reproduction impossible.

Committees have been formed also to study the subjects of redwood distribution, variation, and the most efficient commercial use of redwood products, in the belief that nearly all the purposes for which this lumber is now used can be adequately served by *second-growth trees*.

REDWOOD GROVES IDEAL MEMORIALS

One of the first results of the activities of the league has been the donation by

Dr. John C. Phillips, of Boston, of a large sum of money for the purchase of a redwood grove as a memorial to his brother-in-law, the late Colonel Bolling, who fell under circumstances of great heroism in the late war. No more beautiful or effective memorial can be imagined than a grove of these trees, the very name of which, *sempervirens,* is redolent of the idea of immortality.

If those who desire to preserve in a permanent form the memory of their dead would join in a movement to set aside memorial groves, the whole problem of the preservation of the redwoods on a very large scale would be solved. If a tithe of the gold now squandered in ugly and costly monuments, which desecrate the cemeteries throughout the land, were spent on trees, the world would be fuller of beauty and possibly more grateful to those who supplied the money.

In addition to donations of money and trees for such memorial purposes, the league expects to find sympathetic and cordial support for the park among the lumbermen. They know only too well the value of the timber. The timber is their property, and their business is to cut and to realize on it.

It is not fair for a community to ask them to hold this timber, to pay taxes on it, and then to sacrifice their financial interests for the public welfare. It is the duty of the county, the State, and the nation to purchase their holdings at the proper value.

The question involved is not local; it is a State, a national—in fact, an international—concern, as the benefit derived from the preservation of the redwoods will be for the people of the nation and the world at large. There is no reason why the lumbermen should abandon their interests without adequate remuneration, although in many cases individuals and companies will donate a certain portion of their timber or sell at low figures.

If the State, before building the highways which made the timber accessible, had approached the lumbermen and made it a condition precedent that a strip of timber on each side of the road should be donated, no doubt in many cases the lumbermen would have found it greatly to their interest to accept the proposal. The fact that this was not done was the fault of the State, its highway commission, and its legislature, and not the fault of the lumbermen.

Experience has shown that the only effective, persistent, and intelligent conservators of wild game have been sportsmen who have evolved from game-killers into game protectors, and personally the writer believes that the lumber owners themselves, who are among the finest men on the coast, will be found to be most generous and helpful in any scheme looking to the preservation of the timber.

It will cost money to preserve the redwoods—many millions of dollars; but California has no choice. Either the amount needed to save the groves must be supplied today or else a far greater sum will be required ten years hence to purchase a butchered and isolated tenth part of the forests.

REDWOODS NEVER CAN BE REPLACED

If the groves are bought in their present condition and at relatively small cost, it will be a great innovation, because heretofore Americans have followed the wasteful policy of recklessly exploiting wild life, forests, and streams, and then, as soon as the destruction is complete, the policy is changed, game is reintroduced, and attempts are made to reforest the mountains at vast cost. But redwoods never can be replaced.

Of course, lumbering must go on; but most of the purposes for which redwood is now being used can be served from second-growth timber, and there are vast areas of denuded, devastated, and lumbered-over lands which can be made in a few years to supply all the timber needed.

It probably would not be desirable, even if possible, to preserve all the redwood timber now standing, although as standing timber it is perhaps worth to the State many times its value as lumber. This is true, even from an investment point of view, because the value of the timber is increasing by leaps and bounds.

All this is entirely aside from the sentimental considerations against destroying trees of such great age, size, and beauty. No one who has seen these groves can fail to love them. Nature has been so bountiful to California that the Californians are trustees, for the rest of the world, of many of these priceless heirlooms from a distant past.

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RAYS OF SUNSHINE FILTERING THROUGH REDWOODS NEAR DYERVILLE, CALIFORNIA

The telegraph pole in the middle distance serves as a "yardstick" with which to measure the height of these splendid trees. The redwoods are evergreens, the leaves remaining three or four years after they develop. One of the admirable qualities of this species is its imperviousness to decay, a fact which makes it extremely desirable for the foundations of buildings.

Photograph from Charles Willis Ward

THE REDWOOD IN THE CENTER OF THIS ILLUSTRATION HAS A DIAMETER OF TWENTY-TWO FEET

This species, the *Sequoia sempervirens*—immortal Sequoia—not infrequently attains a height of more than 300 feet. Some specimens have been found which tower aloft 340 feet, and it is predicted by lovers of these giants that the *tallest tree on earth* will be found either in Bull Creek Flat or along Redwood Creek, California.

PERU'S WEALTH-PRODUCING BIRDS

Vast Riches in the Guano Deposits of Cormorants, Pelicans, and Petrels which Nest on Her Barren, Rainless Coast

By R. E. Coker

With Illustrations from Photographs by the Author

PERU is preëminently a land of contrasts. A visitor standing upon some moderate eminence by the sea may gaze alternately upon the broadest extension of ocean's smooth surface and the highest and most battlemented mountains of the continent.

If his vision weary of the barren desert stretching between sea and snow-clad peaks, he has but to turn in his tracks to refresh his eyes with the beauty of a verdant tropical valley, where brightly colored birds flit among trees and shrubbery and tropical fruits are watered by melted snows.

The daylight about him is perhaps as brilliant, as dazzling, as sunlight may be upon earth, while he breathes deeply the moderately cool sea breeze blowing fresh from the mighty Humboldt Stream.

He will become enervated by the rays of the tropical sun pouring direct from the zenith, but he may stroll down to the beach and plunge into a surf as cool and invigorating as that of Martha's Vineyard or Monterey.

The paradoxes of Peru might be multiplied, but our interest lies not immediately in these. Rather we are concerned with other links in the chain of circumstances arising from the same fundamental geographical causes.

WHY PERU'S COAST IS RAINLESS

The Humboldt, or Peruvian, Current, supplemented no doubt by the upturning of cold bottom waters, maintains its steady course for thousands of miles, from icy Antarctic latitudes to the Equator. Thus it is that tropical shores are bathed by cold ocean waters, and, with this fundamental contrast, the stage is set for an array of phenomena not fully paralleled in any other part of the world.

Only two events in that interesting series command our present attention. These are the absence of rainfall and the consequent accumulation, through centuries untold, of a mine of wealth which might have been dissipated by a few seasons of rain.

The cause of rain, of course, is the cooling and contraction of a moisture-laden atmosphere. We may think of a wet sponge that is squeezed and forced to give up its water; but when a moist, cool breeze is warmed over sunny lands, it is as if a compressed damp sponge were allowed to expand; instead of giving up water, the sponge is drier than before.

So, when the winds blowing cool from the surface of the Peruvian Current touch the lands that are warmed beneath a tropical sun, expansion or rarefaction occurs, rainfall is prevented, and the atmosphere is dry.

PERU'S DRY ATMOSPHERE PRESERVES ITS GUANO WEALTH

The significance of this, with respect to the famed guano deposits of Peru, easily becomes apparent. In climates of common atmospheric humidity, however numerous the sea-fowl that nest or rest upon islands or mainland, the nitrates of the guano give rise to ammonia and are wasted by evaporation or seepage; but when, as in Peru, year after year guano is laid down beneath a clear, dry atmosphere, the deposit bakes in the sun and its most valuable components are imprisoned for an indefinite period.

Guano, it will be understood, is primarily the deposit of fish-eating birds, into which may be mixed and incorporated—in greater or less proportion—a variety of other substances, such as the

OLD TERRACES ON THE STEEP SIDES OF THE GORGE OF THE RIMAC, WHICH THE PERUVIAN FARMERS OF AN EARLY CIVILIZATION ENRICHED WITH THE GUANO GATHERED ON THE RAINLESS COAST

The ancient Peruvians developed the practice of irrigation to a remarkable degree. Under modern conditions, only the bottom, showing dark in the photograph, is under cultivation. Guano was conveyed from the islands to fertilize such interior farms (see text, page 541).

eggs and bodies of birds and the deposits and the bodies of sea-lions. It may be found mixed with gravel and sand in very small proportion or sometimes to an extent rendering it unprofitable to extract.

Great beds of guano have been formed upon islands of the Caribbean Sea; upon others off the coast of Africa; and upon still others of the southern and far Pacific; yet these guanos are scarcely comparable to Peruvian guano, for in the moist climate prevailing upon such shores the nitrogen is soon lost in the form of ammonia, while the insoluble phosphates remain to form a far less valuable "phosphatic guano."

"Peruvian guano" is practically synonymous with nitrogenous guano and has long been recognized as the best nitrogenous fertilizer—that is, as a fertilizer of generally high nitrogen value in which the nitrogen compounds are found in a condition most readily assimilable by our plants.

PERU'S BIRDS HELP TO SUPPORT HUMANITY

Nitrogen is a primary necessity to the farmer. Whatever may be the importance of adding to the soil potash and other mineral components of our food and our clothing, there never exists a doubt as to the fundamental importance of nitrogen.

THIS FLOCK OF CORMORANTS FORMED NEARLY ONE THOUSAND TONS OF HIGHEST-GRADE GUANO IN ONE YEAR (SEE TEXT, PAGE 546)

This is the most important guano-producing bird of the rainless coast, and the native Peruvians long ago recognized this fact, giving it the name of *guanay*, meaning, apparently, "the guano bird." Guanays occur on the Peruvian coast from near the northern to the extreme southern boundary, but the principal habitat is the double group of islands off the port of Pisco—the Chinchas and the Ballestas.

Neither is there a doubt as to the critical nature of the practical problem of maintaining a supply of this element in a form available for agricultural uses.

Nitrogen exists in the atmosphere above and about us in almost incalculable quantities, but the problem of supply arises from the limited means and agencies for its fixation in a form in which it can be utilized. There is always a tendency, too, for this elusive element to return to Nature's great store, and it can be recovered again only by slow natural processes or expensive industrial methods. So often as the odor of ammonia arises from wastes or decaying substances, so often is nitrogen being lost—for the time—to further useful service.

Only within recent years have mechanical methods been devised to supplement the natural agencies upon which we have hitherto depended to make a small portion of the nitrogen of the world serve the purposes of man. But such methods are expensive, and doubtless for a long time we will continue to depend principally upon the utilization of organic wastes for nitrogen.

Consequently a peculiar interest attaches to birds of the Peruvian islands, which have long served to aid the world's agriculture and which, given due protection, may continue indefinitely to contribute materially to the support of humanity.

THE ANCIENT PERUVIANS PROTECTED GUANO-PRODUCING BIRDS

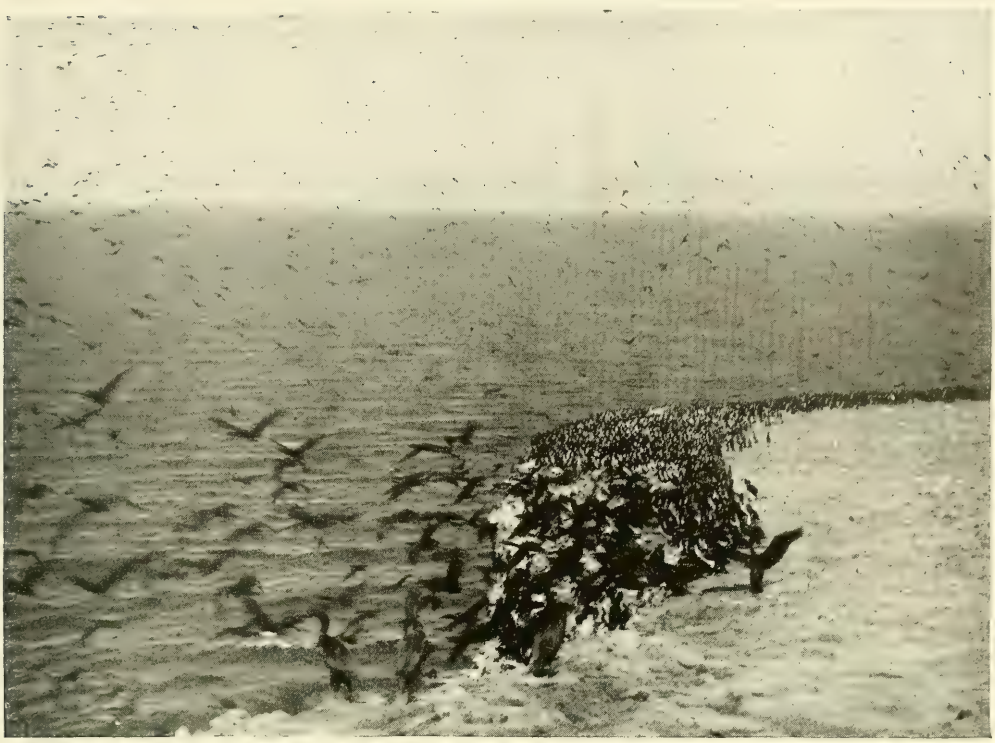
Peruvian guano has been imported largely into Great Britain, Europe, and the United States for many decades. Its employment as a fertilizer on the South American continent is far more ancient. Centuries before the beginning of mod-

A GENTLE SLOPE DOTTED WITH THE NESTS OF WHITE-BREAST CORMORANTS: CHINCHA ISLANDS

After the nests had been occupied for three years, an acre of the ground was covered with guano worth $60,000 or more. This rookery comprised about fifteen acres.

A GUANO-BIRD COLONY ON ONE OF THE BALLESTAS ISLANDS

The guanays well deserve their name. Their gregarious habits, their choice of level ground and gentle slopes for their nesting places, and their custom of remaining on land a large part of the time combine to result in the formation of enormous deposits of guano.



THE AIR AS WELL AS THE CLIFF-TOP IS ALIVE WITH GUANAYS

When walking, these birds suggest penguins, with their erect, waddling gait; in flight, they form long, black clouds, miles in length.

ern American agriculture, there existed on the west coast of South America a civilization of high attainments in agriculture, in textile industries, and in architecture.

The ancient Peruvians found their westward land a vast desert in its natural condition, except for a few narrow and fertile valleys traversed by inconstant streams. They might have confined their farming operations to the shores of these natural water-courses, but, as an aggressive and intelligent people, they extended their cultivated fields far over the naturally arid wastes.

This they accomplished by developing a science of agricultural engineering marked by extensive irrigation works, with canals and ditches that followed the contours of hillsides, tier after tier, or pierced sharp ridges with remarkable tunnels.*

* See "The Staircase Farms of the Ancients," by O. F. Cook, in the NATIONAL GEOGRAPHIC MAGAZINE for May, 1916.

The great obstacle Nature had placed in the way of their agriculture being overcome, they found upon the coast and islands a unique compensation for their difficulties. The same conditions which made the lands naturally arid had also conserved to them the best of agricultural aids in Peruvian guano.

They took fertilizer from the islands to enrich the lands, even in the high altitudes of the montaña, two or three miles above sea-level. Incidentally they left in the kitchen-middens of the camps upon the islands relics of pottery and metal-ware suggestive of an origin of the guano industry dating back at least to an early period in our Christian area.

These early Americans appreciated the value of the producing birds, and they not only enacted most rigorous edicts for the protection of their feathered benefactors, but, according to the account of the Inca Garcilasso de la Vega, they so administered the industry of guano extraction as to make possible the effect-

A PORTION OF A FLOCK OF NEARLY THREE-QUARTERS OF A MILLION WHITE-BREAST CORMORANTS ON ONE OF THE CHINCHA ISLANDS: PERU

This flock nested on a triangular body of land between 20 and 30 acres in area—a rookery which for size and compactness can scarcely be equaled anywhere in the world.

ive conservation of the resources with which Nature had endowed them.

GUANO INTRODUCED IN EUROPE

With the Spanish conquest and the consequent decline of agricultural and industrial life, the guano industry fell away to a condition of insignificance until near the middle of the last century. Humboldt, about 1804, brought samples of Peruvian guano to Europe and advocated its commercial importation.

This great scientist and traveler is usually, but erroneously, given credit for the introduction of guano to Europe. He was indeed responsible for errors of statement that may have been deplorable in effect upon the future conduct of the industry of guano extraction. He attributed the guano to birds of land rather than marine habit and he supposed that current deposits were of the slightest importance. His statement furnished no incentive to the protection of the useful birds.

Up to about 1840, however, the beds remained virtually undiscovered to the foreign world. Existing then in practically undiminished quantity, the deposits represented the accumulation of thousands of years, lying in thick beds, exposed or deeply buried, and waiting only to be shoveled up and loaded into ships for conveyance to the markets of the world.

After guano was actually introduced to the foreign markets, about 1843, there began an era of extraction on a scale hitherto unknown. Islands were surrounded by vessels, fifty or more at a time, and each year saw the disappearance of hundreds of thousands of tons.

DEPOSITS MORE THAN 100 FEET DEEP

It is stated that more than ten million tons were extracted between 1851 and 1872 from one small group of islands, representing an average annual exportation to the value of twenty or thirty millions of dollars. A single island, it is said, was lowered more than a hundred feet by the removal of its thick crown of guano.

The possibility of exhaustion of the deposits was not then contemplated, and no thought was given to conserving the birds.

While private fortunes were being gained, the government was making and executing great plans for public improvements, and the future of the guano industry was heavily mortgaged to defray the expense. Cries of warning came from the country's creditors, as rumors of probable exhaustion spread abroad and threatened the security of foreign-held bonds.

On all sides there appeared a mass of literature in the form of notes, pamphlets, and books that dealt almost as much in invective, charges, and countercharges as in actual analysis of the situation. A readjustment was finally made in the last decade of the century and the industry has continued both for home agriculture and for export, but in a regularly declining condition as regards the export trade.

THE SEA SUPPLIES THE FOOD FOR THE GUANO-PRODUCING BIRDS

The innocent agents in the production of the mines of wealth that were the basis of this world-wide commotion were the numerous sea-fowl of the coast, which found their abundant food in the ocean and made their nests upon the islands or points of shore.

The peculiar climatic conditions previously mentioned offered merely the proper environmental conditions for the preservation of the product. The primary requisite for abundant bird life is the existence of a plentiful food supply, and this is found in the schools of small fish, called anchobetas, that swarm in the Peruvian Current. There "shoals" of fish, acres in extent, are often pursued in the water by bonitoes and other large fish, while beset from the air by thousands of birds.

Billions of pounds of fish must be consumed each year by the birds, besides the incalculable quantity devoured by other fishes; but the fecundity of the anchobetas is such that their numbers are still maintained. At times great areas of the sea are made red by myriads of small, brightly colored shrimp-like crustacea; and these, too, play a part of importance as food for the fishes and birds.

Not all of the birds are of equal importance from the commercial point of view. Indeed, three species virtually support the guano industry at the present

PIQUEROS COVERING THEIR YOUNG: GUANAPE ISLANDS

The piqueros are the most abundant of Peru's sea-fowl and would rank first among guano-producers were it not for the fact that they build their nests on cliffs and in places inaccessible to guano-gatherers.

time—the white-breast cormorant (*guanay*), the big gray pelican (*alcatraz*), and the white-head gannet (*piquero*).

"THE GUANO BIRD"

Of less present significance are the cave-dwelling penguin and the small diving and burrowing petrel, the latter flying back and forth by night from the high seas to their subterranean homes. All the birds, however, so far as they use the islands for breeding or for resting, contribute in some measure to the general supply of guano.

Three species of cormorant are numerous on the mainland coast and islands of Peru. They are pronouncedly distinct in plumage and in habit and of equal interest to the naturalist, but only one is of particular economic significance. The white-breast cormorant is the most important guano-producing bird of the coast, and the native Peruvians, having long recognized it as such, have called it *guanay*, meaning, apparently, "the guano bird."

Strangely enough, many writers have not recognized this bird as the principal

guano-producer, possibly because, in spite of its abundance, it is less familiar than many others. One may not visit a pier without hearing the grunts of black cormorants, one may hardly take the briefest trip on the water without seeing the scarlet-foot cormorant scurrying low over the surface; yet a visitor may remain in ignorance of the most abundant species of cormorant, the guanay, unless by chance his boat pass near a cloud of thousands or hundreds of thousands, or unless the solid black crest of some islet be pointed out as a rookery. Not infrequently, indeed, they form small rookeries, but it is typical to find them in immense aggregations.

Guanays occur on the Peruvian coast from near the northern to the extreme southern boundary, but their preëminent home is the double group of islands opposite Pisco, in the south, the Chinchas, and the Ballestas.

A DISTANT VIEW OF THE PIQUERO ROOKERY SHOWN ON THE PRECEDING PAGE

The foam from the surf, in the distance, is seen streaming away to the north, in the Humboldt, or Peruvian, Current.

NEARLY 14,000 NESTS IN AN AREA OF 5,500 SQUARE YARDS

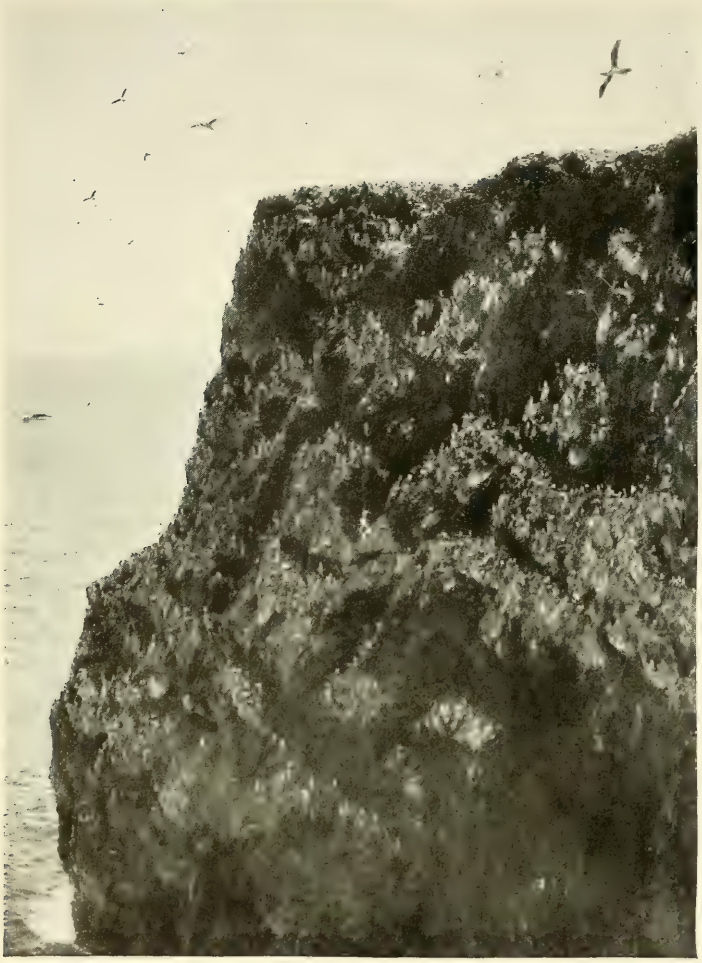
When the Ballestas were visited by the writer, in May, each of the three islands had large flocks of guanays, all of which, however, had been disturbed since the opening of the season for guano extraction.

The smallest of the three flocks had occupied the southwest corner of the north island on comparatively level ground beyond a bluff. The main part of the rookery was bounded by straight lines, being 93 yards in length, with an average width of 59 yards. The area was, therefore, approximately 5,500 square yards, within which were nearly 14,000 nests.

The south island of this group is some 300 feet in height and difficult of ascent. Its small top was nearly half covered with birds in a compact rookery of between eleven and thirteen thousand square yards. The middle island maintained a rookery of nearly equal size. In all, about 150,000 birds had nested upon these three islands during the preceding season.

These flocks seemed large, and where the casual observer immediately says "millions" one is almost reluctant to apply the cold criteria of tape-line measurement, nest-counting, and simple arithmetic; yet, upon visiting the Chincha Islands in the following month, the rookeries hitherto observed seemed insignificant.

Upon the south island of the Chinchas, a small and generally triangular body of land between twenty and thirty acres in area, there was a rookery which for size



A TYPICAL NESTING PLACE OF PIQUEROS

The piquero, or Peruvian gannet, is much more pleasing to the eye than the pelicans or the guano-producing cormorants. The adult bird is distinguished by snow-white head, neck, and breast and variegated back. It is swift and graceful in flight.

and compactness can scarcely be rivaled in any part of the world. Two illustrations herewith (pages 539 and 542) show small portions of the flock without duplication. Taken together they show considerably less than half of the entire aggregation.

The nesting ground occupied about two-thirds of the surface of the island, embracing the crown and the gentle slopes of the hill that surmounted its low bluff walls. The nests were very uniformly spaced, averaging nearly three to the square yard, and not a yard of ground within the outside limits of the rookery was unoccupied. In form and arrangement the nests appear as heavy rolled-rim basins stuck into the hillside (see p. 540).

GUANAYS GRUMBLE AT VISITORS

When one approaches the rookery the guanays crowd away with much grumbling, and when once a few birds arise in flight the movement is liable to spread through the entire flock, until hundreds of thousands are on the wing, even most of those that were too remote from the intruder to know the cause of the disturbance.

If one awaits motionless and with much patience, the birds, after a while, will return to the nests and gradually close in around the observer, until at last only a circle with a radius of three or four feet is left vacant.

While in every direction one is surrounded by acres of birds of the same species, the scene is peculiarly variegated. In one direction the birds face toward the intruder watchfully, and the thousands of snowy breasts make a glistening white ground spotted with black heads. In another direction they are all turned away, and the ground appears almost solidly black; or a thousand birds are seen in side view and the breasts show only as white streaks.

Other effects are presented, according as the birds are more or less compactly grouped. Near at hand the metallic green reflections from the heads, the green-lustered backs, sides, and legs, the showy white under sides and the hun-

IMMATURE PIQUEROS IN A ROOKERY ON ONE OF THE LOBOS DE AFUERA ISLANDS

There is scarcely an island or a high point of shore along the Peruvian seacoast whose steeper walls are not dotted with the nests of piqueros, also known as Peruvian gannets and camanays.

dreds of intent green eyes may well hold the attention.

The confused sound of countless croaking voices that rise or fall with the state of alarm in the multitude makes an effect comparable to the sullen mutterings of a disgruntled mob of human beings.

While some cormorants, when not nesting, seem to know the land only as a place from which to dive, guanays in multitudes will rest for hours upon the level ground. They generally walk more than their near relatives, and as an individual bird strolls about in its small circle, the erect, waddling gait inevitably suggests the penguin. At a casual glance the birds shown in one of the illustrations (page 542) might well be mistaken for penguins. In flight they form long, black clouds miles in length, streaming low over the water until they settle down to form a large, black blotch on the surface of the sea.

The guanay well deserves its common name. Its gregarious habit, its choice of the level places or more gentle slopes for nesting grounds, and its custom of remaining on the islands a great part of the time, all combine to cause the formation of enormous deposits of guano, from which there is little natural waste. The guano is also of exceedingly high value in nitrogen compounds.

In the region where this bird was most abundant, about the Chinchas and Ballestas Islands, the climatic conditions were most favorable to the preservation of the nitrates. It is doubtful if the guano of the Chincha and Ballestas Islands is ever wet from atmospheric moisture.

Even though these islands were visited by the writer during the winter months, when the *garua,* or Peruvian fog, prevailed upon the coast, the atmosphere was invariably dry and clear. Consequently the nitrates are effectively preserved, and 14 to 16 per cent and more of nitrogen may be found regularly in the comparatively new guanos, while even the ancient deposits showed nitrogen in proportion of 12 and 14 per cent.

When the islands were closed by the government, in 1906, from the period of

PELICAN ROOKERY ON WEST ISLAND OF LOBOS DE AFUERA

The pelican is the second bird in economic importance among the guano-producers of the Peruvian rainless coast. There are ten species of this bird, widely distributed throughout the tropical and temperate regions of the Old and New World. Most species nest in communities and usually on an island, the nests being rather crudely constructed of earth, gravel, and rubbish. The eggs vary in number from one to four.

The nesting pelican presents a fascinating subject for speculation: In a colony such as this, where the nests are packed together almost like eggs in a crate, each practically identical with all the others, how do the parent birds know their own nestlings? Yet, after a trip to the feeding grounds, sometimes miles distant, ten thousand birds return and each takes its place without confusion. There is no evidence of community responsibility in the pelican state. Every pair of birds provides for its own family.

When fishing the bird usually flies very close to the surface of the water, and when it sees its quarry it plunges obliquely, holding the bill in such a manner as to scoop the small fish into its enormous pouch. The long bill and neck may be thrust deep beneath the surface. Having imprisoned the fish, the bird holds the head up and the bill down, to drain off the water.

THESE PELICANS ON THEIR NESTS SEEM OBLIVIOUS TO THE PRESENCE OF AN OBSERVER: THIS IS ONE OF THE ROOKERIES OF THE LOBOS DE AFUERA GROUP

"There exists a peculiar belief among many persons that the pelican is unaffected by disturbance, since the adults will often stand by their eggs or nestlings when molested." Note the eggs in the left foreground.

ACRES OF PELICAN NESTLINGS ON THE EASTWARD ISLAND OF THE LOBOS DE AFUERA GROUP

Shortly after this photograph was taken, guano operations were begun on this island; whereupon the rookery was abandoned by the birds.

PELICANS ON THEIR NESTS: WEST ISLAND, LOBOS DE AFUERA GROUP

Only a portion of a flock containing between 20,000 and 40,000 birds is shown in the photograph.

November to March, inclusive, it was determined that the south island of the Chinchas should not be reopened for a period of years. The following summer, 1907, the island was visited, and it was estimated that about 5,000 tons had accumulated. The island was revisited in July, 1908, when the deposit was estimated at 12,000 to 15,000 tons. Extraction of guano was resumed in March, 1910 (after closure for three and one-third years), and the amount of guano taken amounted to more than 22,000 English tons.

BIRDS WORTH $15 A PAIR

It is evident that a pair of guanays, with their offspring, produce nearly one dollar and fifty cents' worth of guano per year, besides leaving their progeny to continue the service in future years. Since they produce this income without expense except for protection, the fowl may be conservatively appraised as having a value of $15 per pair; and though this may seem a fancy value for common cormorants, yet the commercial returns justify such an appraisal.

It was found that the deposits accumulated on the south island at the rate of about 4½ inches per year, or nearly 300 pounds per square yard. A few acres of such rookeries constitute a fortune indeed.

Two other species of cormorant are familiar residents of the coast. The black *cuervo de mar,* or "sea crow," is comparable in habit to our eastern American fish cormorants. They haunt the shores and the piers, whence they make short dives after fish, taking into their expansive throats even comparatively large fish. The nests are found on the rougher outlying rocks.

The *patillo,* or "little duck," is peculiar among the cormorants of the coast in living in isolated pairs, with homes on the cliffs or in the caverns; in constructing strong and heavy nests of seaweed, straw, or other accessible materials, and in having a high-pitched, cheeping note. It is sometimes known as the "chiquitoy," or "chuita," names probably referring to its voice, which is suggestive of a small song-bird.

It is a notable illustration of the adaptability of nature that three species of birds so closely related as these three Peruvian cormorants should in the same general environment manifest such striking contrasts in habit.

THE GRACEFUL PERUVIAN GANNET IS FOUND ON EVERY ISLAND

More pleasing to the eye than any cormorant is the common Peruvian gannet, the "piquero," or "camanay," with its snow-white head, neck, and breast and variegated back, its clean, elegant form, and swift, graceful flight. Everywhere present on the coast, it undoubtedly is the most abundant of the sea-fowl.

There is scarcely an island or a high point of shore but its steeper walls are dotted with nests of piqueros. Were it not for this habit of choosing for its nesting place the cliffs and more inaccessible places, the piquero would, perhaps, take first rank as a commercial bird. Doubtless in time, when the industry is better organized, practicable arrangements may be made for conserving a large proportion of the fertilizer which is now wasted from the abrupt cliffs. At the present time the piquero ranks third in commercial importance.

WHEN THE AIR "RAINED BIRDS"

It is always a striking sight when a single gannet, after circling over the water until its prey is seen, turns head down and falls precipitately into the sea, to disappear beneath the surface; but on one occasion the writer had a rare experience while passing from the Chincha Islands to the port of Pisco in a fisherman's rowboat.

An actual cloud of thousands of piqueros was seen flying over a large school of anchobetas. Suddenly, as if at a given signal, they began to fall into the water, hundreds at every moment, until within a few seconds practically the whole cloud had emptied itself into the ocean.

The air was almost clear of birds before the first had risen from their brief rest after emerging from beneath the surface. These were soon up again, and the repeated plunges then continued without interruption. Changing a little the course of our boat, we soon rowed directly through this downpour of birds.

One can scarcely imagine a more interesting or bewildering situation. The at-

A SMALL INDEPENDENT PELICAN ROOKERY ON ONE OF THE LOBOS DE AFUERA ISLANDS

The food of the pelican consists almost entirely of fish.

mosphere was actually cloudy with many thousands of fowls that were raining incessantly into the water; the whole surface of the sea was broken and spattering from the fall of animate drops and speckled with the glossy white of the reappearing birds, while the air was filled with the whirling of wings and the sounds of hundreds of splashes at every instant.

One of the accompanying illustrations (see page 546) shows a high cliff, at the Chincha Islands, dotted with nests. Almost universally the nests were found either upon cliffs or upon very steep and rugged slopes high above the water, where approach could be made only with considerable difficulty. Every day in the year one may find eggs and all stages of young at the nesting places, for the piquero has no favored season of breeding.

The naturalist and traveler, von Tschudi, who supposed this species to be the bird of chief importance, found that a single specimen would produce 3½ to 5 ounces of guano per day. Assuming that one ounce of this was deposited at the island each day (a low estimate), it is evident that a million piqueros would produce 356,000,000 ounces per year, or 11,400 tons—guano to the actual value of a half million dollars. Beyond question, the gannets of the Peruvian coast would far exceed a million in number, but in the present condition the product is practically all wasted.

THE HOMES OF THE PERUVIAN PELICANS HAVE BEEN DEVASTATED

Most conspicuous of all the birds of the Peruvian islands is the large pelican, or "alcatraz," which is seen along the entire coast. It was observed to be much more abundant in the north, but this probably was due not so much to climatic conditions as to the fact that the larger islands of the north afforded more congenial environment for nesting.

Residents of Pisco, and others whose connection with the guano industry has taken them into that region during past years, tell of the former great abundance of pelicans in the southern region, from the Chincha Islands to the Santa Rosa, in the Bay of Independencia. If such had been the condition, and many evidences supported the personal statements, a great change had occurred. Only a

BIZARRE AS THE ADULT PELICAN APPEARS, IT IS A GRACEFUL AND ELEGANT BIRD COMPARED WITH THE GROTESQUE NESTLING

At first naked and purple-skinned, then covered with white down, the nestling's awkwardness seems to increase with age. It attains a large size before developing its second plumage. Even when only slightly feathered, it may exceed its parents in stature and weight.

very few pelican nesting grounds could be found during the writer's visit.

The Chincha and Ballestas Islands were largely given over to the cormorants, San Gallan to the little petrel, and the Santa Rosas to small terns. Upon the Lobos Islands, however, the pelican was the bird of paramount importance. In March it was estimated that one rookery comprised upward of forty thousand pelicans nesting or rearing young and fully as many more of nestlings and flying birds in immature plumage. The eastward island of Lobos de Afuera, with its outlying islet to the north, contained close to, if not exceeding, one hundred thousand pelicans.

Such an array of pelicans makes a more showy effect than a vastly greater number of smaller birds.

Unfortunately, this great and valuable rookery, unmolested for several years, was not permitted to remain further undisturbed. Following the writer's visit the nesting grounds were invaded by extractors and were stripped of guano and nests. When the islands were revisited in December scarcely any birds were near the old rookery and only a couple of thousand nests were anywhere upon this island.

Upon the north point of the westward island the largest rookeries were found, including between twenty and forty thousand birds. Still other nesting grounds had become established upon the Lobos de Tierra Islands, thirty miles farther north, at a point on the island well removed from the scene of guano extraction.

It is one of the tragedies of the guano industry that this important bird has received so little proper consideration that its numbers are now greatly reduced.

There exists a peculiar belief among many persons that the pelican is unaffected by disturbance, since the adults will often stand by their eggs or nestlings when molested. Every fact known regarding the movements, migration, and gradual extermination of the pelican confirms the belief that the species suffers more detriment from the molestation of its homes than perhaps any other bird found on the coast. The time may arrive when the pelican will have become so depleted as to be of comparatively slight significance.

The subordinate economic importance of the pelican relative to the guanay is told, not only by comparison of the numbers of birds of the two species, but also by analysis of the guanos. To some ex-

tent, however, and perhaps entirely, the inferiority of recent pelican guano is attributable to climatic conditions prevailing on the particular islands where the birds have found safe harbor.

As far north as the Lobos Islands, atmospheric humidity becomes appreciable and, indeed, light showers, though extremely rare, are not unknown. Fresh pelican guano from the Lobos de Afuera Islands gave, by analysis, more than 21 per cent of nitrogen, while random samples of dry guano from the surface of the rookery yielded less than 8½ per cent. Comparison of these analyses reveals the deleterious effect of atmospheric conditions in this locality.

Comparison of the last analysis with the guanay guano of the Ballestas Islands, with its 12 to 16 per cent of nitrogen, shows the inferiority of northern pelican guano to southern guanay guano, although this comparison tells no story of the relative merits of the birds when subjected to the same climatic conditions.

AN OLD PELICAN WHOSE PLUMAGE HAS BECOME ALMOST COMPLETELY GRAY

The bill in one species of pelican sometimes measures 18 inches in length. They are strong fliers, their wingspread often reaching ten feet. On the Peruvian coast both the adult birds and the nestlings are beset by parasites, which attach themselves by scores within the pouches.

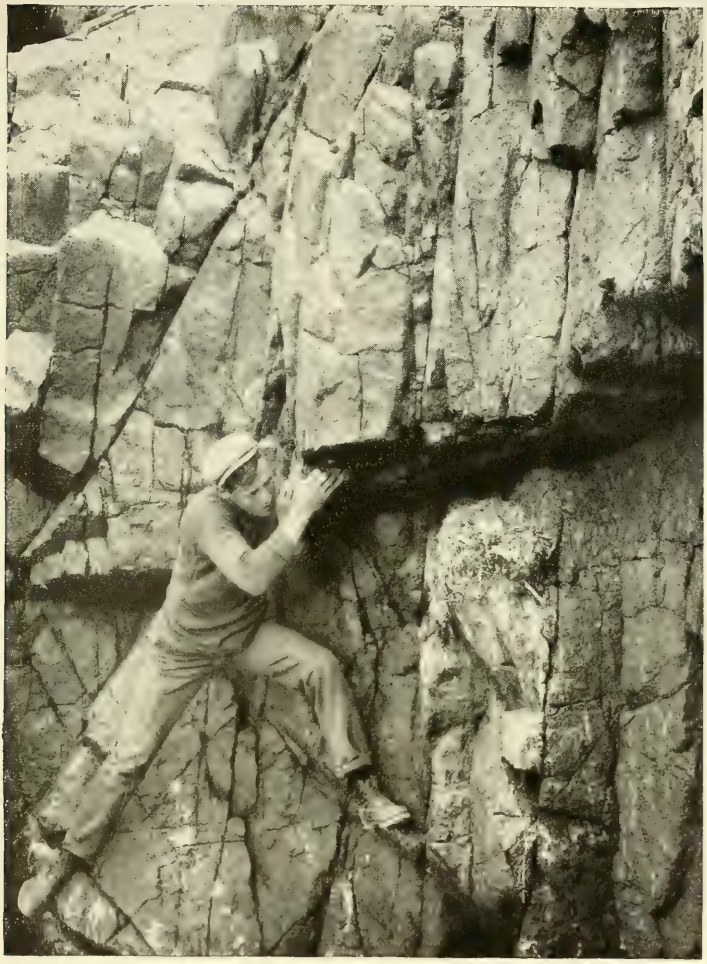
THE PELICAN YOUNG ARE NAKED AND AND PURPLE-SKINNED

Regardless of its economic rank, the pelican yields to no other bird of the Peruvian islands in interest to the observer or in the problems it presents for study.

When one first visits an island inhabited by great numbers of these large birds, the bewildering variety of color phases may well suggest the presence of several species. Longer acquaintance, however, shows that there is but one common Peruvian pelican, which at various ages and seasons displays itself in a diversity of dress. There are patterns corresponding to particular stages, and, since the periodic changes of costume take place somewhat gradually, there are various combinations of the several patterns.

It is interesting, too, to observe the young birds at various stages of growth. Bizarre as an adult pelican may appear alone, it loses by comparison all suggestion of grotesqueness when in company with its nestling young. At first naked and purple-skinned, then covered with white down, their awkward and uncouth appearance seems for a time only to increase with age.

Attaining a large size before developing their second plumage, they may even exceed their parents in stature and in weight while only slightly feathered. Great down-covered giants they then appear, while still requiring to be fed from mouth to mouth by their parents. The bill, though relatively short and nondescript in appearance, gives indication of its future style, and the expansive throat



A PERILOUS CLIMB TO REACH THE HOME OF A "PATILLO," A SPECIES OF CORMORANT WHICH BUILDS ITS NEST ON PRECIPITOUS CLIFFS OR IN CAVERNS

Unlike the white-breast cormorants, the patillos ("little ducks") live in isolated pairs. The nests are strong and heavy, being constructed of seaweed, straw, and other accessible materials.

is fully capable of engulfing the long beak of the parent to receive the food which the latter disgorges into the infantile interior, according to the well-known practice of the pelican and its relatives.

Both old and young are beset by parasites. The nesting grounds are made rather disagreeable by the large number of these that not only infest the birds, but swarm upon the ground and extend their explorations to the observer.

These insects attach themselves by scores within the pouches of the pelicans. In fact, the writer found that it was comparatively easy to rid himself completely of these pests by brushing them off as they passed the neck, for they never delay their steady march toward the supposed position of a bill. It is not surprising that the pelicans spend much time bathing and splashing in the water in any quiet cove along the shores of their islands.

THE STRANGE HABITS OF THE DIVING PETREL

Turning from the largest to the smallest of Peruvian guano birds, the little diving petrel commands attention. Though comparatively abundant, it is rarely seen.

No other marine bird has developed so effective a habit of retirement. By day, while one of the pair is brooding on a subterranean nest, the other is usually far out on the ocean, resting quietly or making short dives for prey beneath the surface.

On sea or land, there is scarcely a movement to attract attention to the bird. With the fall of darkness, all is different. From beneath the ground come the soft repeated calls, bewildering to an observer who is unacquainted with the cause. The air becomes filled with the sound of quick wings and gentle croaking voices, as little dark objects flit batlike back and forth.

THE PETREL RESEMBLES A FEATHERED TERRAPIN

A ball of feathers emerges from an unnoticed opening in the ground, seems to roll rapidly a short distance, and then

rises in flight direct for the sea; another, coming from the ocean, disappears mysteriously into the ground to replace a complaining mate.

When taken from the burrows, the little bird is found to measure ten inches in length and to weigh half a pound. The general color is black above and white below, while beneath the feathers is found a thick, gray down. The dense coat gives an appearance of large size to the body, while the little wings and short, stout neck seem disproportionately small appendages. When its body is flattened out on the ground, this diving petrel strangely suggests a feathered terrapin.

Off the Peninsula of Paracas, near Pisco and just across the "Narrows," is the lofty San Gallan, marked by several peaks that reach an altitude of 1,200 to 1,400 feet. The tops of these hills are more or less concealed by clouds, which serve as Nature's weather signals to the local mariner. "When San Gallan puts on its cap" of heavy clouds, the prudent sailor avoids the Narrows and delays his southward trip. Here was the preëminent home of these diving petrels, or "potoyuncos," as the Peruvians euphoniously call them. From the lower desert slopes of San Gallan's hills to the verdant cloud-bathed peaks, everywhere were large patches of ground undermined by short burrows.

Small as the "potoyunco" is, the guano from its nests is valued for its high quality. Unfortunately, the meat is likewise esteemed by the native fishermen and laborers, and the array of discarded wings strewn about many of their nesting places reveals the occurrence of ruthless depredations. Unless effective measures be taken to prevent, the potoyunco will gradually but surely incur the fate of the penguin and other birds whose habits and defenselessness lay them open to destruction.

A tropical penguin may seem another Peruvian paradox. Nevertheless, penguins are quite common on the coast of

THE YOUNG PATILLOS IN IMMATURE PLUMAGE ARE WELL CONCEALED AGAINST THE GRAY BACKGROUND OF THE ROCKS

Because of its high-pitched, cheeping note, this species of cormorant is sometimes called "chiquitoy," or "chuita," suggesting a songbird.

THE BEACH-CLEANING BRIGADE OF THE PERUVIAN RAINLESS COAST: SCAVENGER SEA-GULLS

Peru, occurring even as far north as the Lobos de Afuera Islands, which are within a few hundred miles of the Equator. This, of course, is because the ocean off Peru is not tropical, but is constantly chilled by waters that stream from Antarctic regions to the Equator.

Penguins are naturally more numerous toward the south. Almost every cavern beneath the Chincha and Ballestas Islands reveals its quota of nests. The largest number of penguins seen at one time was grouped upon a beach of the Isla Vieja, in the Bay of Independencia, a little more than 14 degrees south. They were about sixty in number, a few of them showing plumage of an immature stage.

The Peruvians have given penguins the suggestive name of *"pajaro niños,"* or "baby birds," in reference to their infantile, waddling gait when walking with the reduced wings held stiffly from the body like the helpless arms of an infant.

The guano of penguins is limited in quantity and liable to be moistened by the spray from the waves dashing into the caverns they prefer to frequent. Nevertheless, when obtainable in good preservation, it is highly esteemed.

Penguins are also valued for the oil, and the fishermen seek them for their skins, while sailors kill them "for fun." Close, hairlike feathering makes the skins adapted for the fashioning of "fur" caps.

BIRDS OF DIFFERENT FEATHERS THAT FLOCK TOGETHER

There are many other interesting birds of the Peruvian islands. Petulant blue Inca terns, with white curled "moustache," dart excitedly into your very face almost, but nest prudently in the rougher places, where the homes may be protected under shelving portions of guano or in rudimentary burrows.

Pearly gray terns practically cover the south Santa Rosa Island with nests which are so indistinguishable amidst the gravel and guano that one unavoidably crushes the eggs in walking about; the nestling birds, however, are never trampled, for they are too quick and clever at concealment.

Noisy gulls of several species nest scatteringly on various islands. Shore birds, such as curlews, oyster birds,

plovers, and sandpipers, frequent the margins of the islands, especially where sandy beaches are available.

Scavenger buzzards, or "gallinazos," profiting by the experience of other birds, upon whose eggs and young they love to prey, conceal their own nests in caverns or beneath overhanging rocks.

Large condors are occasionally seen posing silently on some high hillside, and a lonely species of perching bird, the little "chirote," also has found its way from Andean slopes to the barren sea islands, where it flies back and forth from cliff to beach or runs along the water's edge in search of tiny prey.

Sailing from island to island or back and forth from mainland to island, one may meet typical birds of the high seas: dull-colored shearwaters, little petrels that hover over the waves or seem to dance upon the surface of the sea, and, more conspicuous than these, the beautiful Peruvian albatross. The last, though smaller than the great southern albatross,—its body, indeed, scarcely larger than that of a gull—has yet a wing expanse of eight feet.

ALL THE GUANO ISLANDS LIE NEAR THE MAINLAND

To mention the places where guano deposits have been found would be almost to list the islands, islets, and points of shore from near Paita, at 5 degrees south, to the southernmost limit of present Peruvian territory, at 18 degrees south—a distance corresponding to that between New York and Cuba, or about 1,300 miles.

The commercial guano situations comprise some hundreds of points, but chief among these, for their historical importance, are the Chincha and Ballestas Islands, the islands of Guañape and Macabi, and the larger Lobos Islands of the two groups, de Afuera and de Tierra. Pabellon de Pica, now beyond the territory of Peru, was also an important point at an earlier time. Among places of second importance are the Islas Santa, Fronton, Palominos, Asia, Santa Rosa, Vieja, and Cerro Azul.

From year to year the scene of the industry may shift from island to island, as the deposits accumulate or become exhausted, but the Chincha and Ballestas and the Lobos Islands are rarely abandoned for a complete twelve months.

None of the islands are very large or far removed from the coast. The nearest islet is so close to the main shore as to be reached conveniently by an aërial trolley, while most of the islands are not more than ten or twelve miles removed. The only group at all remote is the Lobos de Afuera, which is about 33 nautical miles from the nearest point of mainland. The largest island is that of Lobos de Tierra, with its length of nearly six miles and a width varying from one-sixth of a mile to two miles.

The Lobos de Afuera Islands, combined, are slightly smaller, while each of the two larger Chincha Islands will not average a half mile in diameter. The south and smallest island of the latter group, and recently the most important, has an extent of less than 30 acres, and on the occasion of the writer's visits the greater part of its surface was carpeted with the nests of guanays.

The islands of Ballestas, a sister group of the Chinchas, and, like it, composed of three principal units, are each approximately equal to the smallest of the Chinchas. They are bolder and higher and must be gained by climbing from the water, being without beaches except at the bases of unscalable cliffs. These islands of Ballestas are from one to three hundred feet in height.

PRACTICALLY NO VEGETATION ON MOST OF THE ISLANDS

All of the islands are more or less bold, rocky, and barren. Generally, vegetation is entirely absent, except where the higher points reach such an altitude (about 1,200 feet) as to derive moisture from the clouds. The higher peaks of desert islands may therefore support luxuriant, but entirely isolated, gardens of vegetation. These are found only upon such lofty islands as San Gallan, La Isla Vieja, or San Lorenzo.

A small amount of vegetation was seen on the sandy shores of Lobos de Tierra, but this was exceptional. Even if the want of atmospheric or soil moisture did not exclude the possibility of plant growth, the rocky nature of the ground and the general presence of too strongly concentrated fertilizer would render con-

DIGGING AND SACKING RECENT GUANO

The tropical sun bakes the guano into a hard, dry crust, and the fresh, dry breezes seldom carry a trace of odor. Where the material is comparatively recent, the only implements required are picks, shovels, a screen, and a supply of sacks.

ditions generally unfavorable for vegetation.

Naturally the only native land-dwelling inhabitants of such islands, besides the birds and sea lions, are parasitic insects and their enemies—the spiders, scorpions, lizards, and bats—except that on the green-capped peaks colonies of land snails have been introduced, perhaps by the condors, which visit back and forth from mainland to island.

Escaped cats live freely on at least one of the islands, sustaining themselves, no doubt, upon the birds and the shellfish that are easily found upon the exposed rocks between tides. Evidently fresh water is not essential for feline health and prosperity.

There is a distinct difference in the atmospheric conditions of the islands of the north and the south. Nearer the Equator the sea breeze becomes somewhat warmer, and probably in exceptional years the course of the Peruvian Current swings westward a little sooner, permitting the warm equatorial waters to flow southward to the Lobos Islands.

Light rains are not unknown on Lobos de Tierra, and this undoubtedly accounts for the presence of small patches of vegetation and the inferior quality of the mineral guano. The typical conditions of the coast apply fully in the Chincha region, and it is doubtful if a shower has ever fallen upon these islands.

MANY ISLANDS DIFFICULT OF ASCENT

Contrary to expectation, life upon these arid islands has few unpleasant features and a wealth of compensatory interests. Some of the shores are bold and difficult of access, but everywhere that work has been pursued some practicable method of access has been devised.

One may have to make the landing from a small boat, skillfully handled in a plunging surf, by an opportune leap to a bare foothold on the ragged shore rocks. At another island one must take the chance to grasp the lower end of a rope ladder which dangles from an improvised pier hanging out from the side of the island. In other places a smooth cove and an easy beach are at hand.

GUANO BEING CONVEYED FROM MIDDLE ISLAND OF THE BALLESTAS BY AN AËRIAL TROLLEY

The trolley is simple in construction, consisting of two stout wire cables suspended from a frame (see illustration on preceding page) at the top of the island and running to a convenient rock near the shore. A lighter is rowed to a point beneath the lower end of the cables to receive the guano, which is lowered by means of pulleys and windlass.

Some small islands are inaccessible in very rough weather, and the writer has passed entirely around islets that rose out of the surf like big chimneys, with sheer walls of some hundreds of feet, without finding a single place of access by available means. One of these apparently had never been scaled; but, if its small table top contains a few hundred tons of the valuable guano, the eager and intrepid workers will find a means of ascending its walls, and, this once done, the embarkation of the guano will present no extraordinary difficulty.

Once on the islands, the guano is found to be baked into a hard, dry crust under the tropical sun, and the fresh, dry breeze rarely carries the trace of an odor.

Unless one is enslaved to the fresh-water bath and other "comforts of civilization," a camping experience upon any one of the Peruvian islands is never to be regretted. The dependable breeze keeps the air fresh and sweet. By day there are hills to climb, cliffs to descend, and perhaps caverns to explore; there are fish to capture, and the bird-life to study is always too varied for the attention to weary. The night brings its own peculiar charms. Let us cite a particular instance.

A NIGHT SCENE

Lodged upon the side of the North Ballestas Island about 100 feet above the water, the open front of our tent looked directly down upon the silvery glaze of the rising moon, showing broadly and brilliantly on the sea for many miles. Yet there was no stillness to the night.

About us and beneath us were the varied sounds of the surf, roaring against

HEAPING SCREENED GUANO FOR TRANSFER TO THE MAINLAND

the rocky shore, the peculiar resounding crash of a great swell breaking on a bit of shingle beach of the island just opposite, or the fierce boom of a wave that ended a thundering course through a long cavern deep into the heart of the island beneath us.

A short distance away the other, loftier islands of the group were outlined against the sky, while the light of guano camps shone from the tops or from some scant perch on the precipitous sides. The situation was picturesque enough, and measurably isolated, but the dim beacon light of Pisco, ten miles away, and the Danish vessel, rolling near by, gave a sense of contact with the rest of the world.

With the peons engaged in extracting guano it was, perhaps, another story. The camps of the workers were simple indeed. Skeleton frames of wood with covering and walls of burlap or old guano sacks constituted the barracks. They seemed adequate, however, for the climatic conditions.

The foreman's camp was often only a somewhat larger tent of the same construction, though the exporting company usually made some better provision for an officer

The workers were practically all Peruvians of the ancient stock, and many of them came down from the mountains to engage in this work. Often there were few in the camp who could speak Spanish and the foreman could communicate with the employees only by signs or through an interpreter.

THE GATHERING OF GUANO IS A SIMPLE PROCESS

The extraction of guano, as observed, was a very simple process. Where the material was comparatively recent, the only implements required were the pick and the shovel, a screen, and a few sacks. The surface cake was first broken up and thrown into small heaps. Where several contractors had a concession from the government covering the same island, there was much rivalry in getting the best guano mounded, for this was the only recognized method of establishing a claim to a particular field.

The guano was subsequently pitched through slanting wire screens to remove the gravel, and then sacked for embarkation by *lanchas,* which are strongly constructed lighters in the form of rowboats, adapted for use in the heavy swell liable to prevail about the islands.

A CAMP OF FISHERMEN AND GUANO-GATHERERS: LOBOS DE TIERRA

The large house in right background is the office and residence of an American firm, contractor for the Peruvian Corporation. The smaller houses are offices for minor officials.

A DESERTED CAMP OF GUANO-WORKERS: CHINCHA ISLANDS

The workers in the guano deposits are practically all Peruvians of the ancient stock. Their camps are extremely simple, the huts consisting of skeleton frames of wood covered with burlap or old guano sacks.

A SMALL ISLAND NEAR CERRO AZUL, WHERE AN INFERIOR GUANO OF SEA LIONS MIXED WITH BIRD GUANO IS GATHERED

Here the guano is conveyed from island to mainland by aërial trolley (see illustration on page 561), then loaded on burros for conveyance to the plantations in the Peruvian interior.

A very common method of conveying the guano to the lighter was by means of the *andarivel,* an aërial trolley, consisting of two stout wire cables suspended between a frame at the top of the island and some convenient rock somewhat removed from the shore.

The boat would be rowed beneath the lower part of the cable to receive the guano, lowered by pulleys and windlass. Both ends of the line being attached to traveling pulleys, the sacks of guano, descending by gravity, drew the empty sacks back. No power was applied to the windlass except to prevent the too-rapid descent of the guano.

When the lancha was loaded it was rowed out to the vessel, where the sacks were hoisted into the hold.

HALF-HOUR SHIFTS FOR WORKMEN LOADING GUANO SHIPS

The stowing of the guano was the one phase of the work which put a severe test upon human endurance. If the guano was particularly strong, the foreign crews could not be utilized for the task. Native laborers were then relied upon, and even these could remain in the ship's hold for only half an hour or an hour at a time.

A much more extensive equipment was employed on the larger islands of the north. An American company, contracting for the Peruvian exporters, had laid lines of track for conveying the guano by tram-cars, and the screening was done from trestles over a lower-level track. A bridge of some length had even been constructed between the main Lobos de Tierra Island and a smaller island near by.

One could see upon this island several permanent buildings, besides the usual laborers' and fishermen's camps. The largest of these contained the offices and

MANY OF THESE HILLS OF THE LOBOS DE AFUERA ISLANDS WERE COVERED WITH GUANO AT ONE TIME

All of the guano islands are more or less bold, rocky, and barren in appearance. They are without vegetation because of the lack of moisture. Only on the higher peaks, which derive some moisture from the clouds, are there occasional patches of luxuriant green.

SOMETIMES LABORERS DYING ON THE ISLANDS ARE BURIED IN OLD GUANO

Subsequent excavations bring the coffins to the surface. Some of the bodies are almost perfectly mummified, as a result of the dry atmosphere and the effect of the guano.

store of the company, while two smaller buildings housed the representatives of the government and the exporting corporation respectively.

By far the greatest portion of the guano that has been exported consisted of the ancient deposits, called "mineral" guano, which in places covered the islands to great depths. This has been simply stripped away until scarcely any of the old guano remains except some of the lowest grades that scarcely justify exportation.

It is an interesting fact that many deposits were found deeply buried beneath layers of sand and broken rock, and such beds have led some to suppose that the guano could not be of animal origin. The blowing sand and falling rocks from the weathering hills would readily explain the covering of old beds.

MILLIONS OF TONS OF GUANO LOST

When one watches the present accumulation of guano at the rate of more than four inches per year in some places, or at the probable rate of twenty to thirty thousand tons per year along the entire coast, the wonder is, not that the great beds should have accumulated, but that so few millions of tons should have been found. In past times, undoubtedly, great losses must have occurred from the falling of cliffs undermined by the surf, from the breaking up of the islands by the slow, wearing action of the waves, and perhaps from slight subsidence due to seismic disturbances.

It is within the bounds of possibility that additional deposits, buried beneath the surface, may yet be located. Unless this be the case, the industry is permanently reduced to the annual deposits, which scarcely exceed the demands of Peruvian agriculture in its present condition, without providing for the great future developments in land cultivation in that country that must follow sooner or later with the adoption of more elaborate systems of irrigation.

Since the important birds have been greatly reduced in numbers, it is reasonable to expect a substantial increase under natural conditions, if interference with the breeding be reduced to the minimum consistent with the utilization of the deposits. The future of Peruvian agriculture and industrial life seems rather closely linked with the protection of the guano birds.

It is a fortunate thing to have such an appealing commercial reason for the fostering of the birds. Government, mortgagees, and agriculturists must sooner or later combine effectively to obstruct the extermination of these resources and to promote an increase to the maximum number of birds permitted by Nature.

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